THE

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CONCERNING THE SUPPRESSED BOOK.

By E. L. YOUMANS.

IT will be no news to the readers of this monthly that the volume entitled "The Nature and Reality of Religion; a Controversy between Herbert Spencer and Frederic Harrison," published by D. Appleton & Co. last March, has been suppressed by order of Mr. Spencer. This catastrophe was the result of a public correspondence carried on between these gentlemen in the columns of the London "Times." Fragments of the letters were cabled to this country as they appeared, and were widely disseminated by the newspapers, producing some suspense, and giving a confused impression of the affair. At length came the announcement that the disagreeable difference was happily composed; but with it came also a dispatch ordering the destruction of the book—copies, plates, and all—the damage to be charged to Mr. Spencer. This seemed a curious way of bringing an unpleasant difference between two authors to a harmonious termination; but, without waiting for explanations, the mandate was obeyed and the book suppressed. The letters themselves are now before us, and as they have not all been previously published in this country, they are herewith submitted to the reader in full:

THE SPENCER-HARRISON CORRESPONDENCE.

[*London Times, May 29, 1885.*]

A NEW FORM OF LITERARY PIRACY.

Mr. Frederic Harrrison has forwarded to us for publication the inclosed letter which he has addressed to Mr. Herbert Spencer:

"*May* 28, 1885.

"DEAR MR. SPENCER: I can not admit that there is anything to justify you in being a party to the American reprint of articles of mine, without my knowl-

edge or consent. I learn accidentally that a volume has appeared in New York, which consists of three recent articles of yours in the *Nineteenth Century*, printed alternately with three recent articles of mine, with an introduction, notes, and appendix. This re-issue of my articles was made without the knowledge of myself, or of the proprietor of the *Nineteenth Century*, and he tells me that it is a case of piracy.

"You now avow (in your letter to me of yesterday) that the volume was issued by your American publishers, and was edited by your friend Professor Youmans, after consultation with you, with your consent and assistance. You also avow that you furnished the editor with controversial comments on my articles, and requested him to append them in his own way—that is to say, you have abetted a clandestine reprint of three articles of mine, interpolated with notes supplied by yourself. I regard this, not only as an act of literary piracy, but as a new and most unworthy form of literary piracy. May I ask if it is proposed to hand you the profits of a book of which I am (in part) the author, or are these to be retained by your American publishers and friend?

"To justify this act you now write that you expected republication in America by my friends. This expectation rests, I can assure you, on a pure invention. No friend of mine, nor any person whatever in America or in England, has ever suggested to me the republication of my articles, nor have I ever heard or thought of such a project. You quote to me, as your authority, a letter from Professor Youmans, who simply says there is danger of its being done by others, and he adds that I am coming to lecture in America. Again, this is a pure invention. I have never thought of lecturing in America, or of going there, nor has any one on either side of the Atlantic suggested to me to do so. Those who 'convey' my writings will as readily invent my intentions. Inquiry would have shown that neither I nor my friends had any intention of reprinting any articles—much less yours. And I fail to see how an unverified report that they might be reprinted, coupled with an unverified report that I was going to lecture in America, could justify you in promoting and assisting in the unauthorized issue and sale of writings of mine.

"This is not a simple case of clandestine reprint. Those of us who do not take elaborate precautions are exposed to have what they write appearing in unauthorized American editions. But it does surprise me that an English writer should connive at this treatment of another English writer, with whom he had been carrying on an honorable discussion. It is, I think, something new, even in American piracy, to re-issue an author's writings behind his back, and sell them interlarded with hostile comment. Reprints, even while they plunder us, spare us the sight of our sentences broken on the same page with such amenities as 'he complacently assumes,' 'loose and misleading statements,' etc. You avow, in your letter of yesterday, that you supplied these comments to my articles; and if internal evidence did not show them to be yours, by your offer to me to republish them now in England, you treat them as yours. I know no instance of such a practice. It is as if I were piratically to reprint your 'Data of Ethics,' freely interspersed with a running commentary on your practice of ethics, and were to justify my act on the ground that I had had a controversy with you, and that I had heard your friends were about to reprint it.

"There is one minor point which serves to show the kind of publication in which you have chosen to take part. My articles in this volume are followed by a cutting from a newspaper account of what the editor calls 'The Little Bethel of the Comtists.' As the volume bears as its subtitle the words, 'A Con-

troversy between Frederic Harrison and Herbert Spencer,' that newspaper paragraph would only be relevant if it referred to practices in which I had some part, or which I approved. It is well known that I have nothing to do with anything of the kind, and never countenanced it. Nothing of the sort has ever been heard in Newton-hall, where for years past I have presented Positivism as I understand it. The matter is a small bit of polemical mischief; those who are engaged in plunder are not likely to be fair. But I think it is quite unworthy of a place in a volume for which you are responsible, and which you have authorized and adopted.

"You now propose to me to republish this volume in England, where you admit it could not appear without the consent of all concerned. After what you have done I must decline to act with you. I leave your conduct to the judgment of men of sense and of honor.

"I am faithfully yours,

"Mr. Herbert Spencer. FREDERIC HARRISON."

[*Times, June 1st.*]

MR. FREDERIC HARRISON'S CHARGE.

To the Editor of the Times.

SIR: Will you oblige me by publishing the following letter, which is a copy of one to Mr. Harrison, referred to by him in his letter contained in *The Times* of Friday:

"38 Queen's Gardens, Bayswater, W., May 27, 1885.

"DEAR SIR: Here are my replies to the questions put in your note of yesterday.

"Just before the middle of January I received from my American friend, Professor Youmans, a letter dated January 2, containing, among others, the following paragraphs:

"'And now we have something of a new embarrassment upon which I must consult you. There is a pretty sharp demand for the publication of your controversy with Harrison in a separate form, and the publishers favor it. The question is not simply whether it is desirable, for we can not control it. There is danger that it will be done by others, and if that should occur it would be construed as a triumph of the Harrison party—the Spencerians having declined to go into it.

"'If I thought no one else would print the correspondence (*i. e.*, the *Nineteenth Century* articles), I should be in favor of our not doing it. In the first place, for general effect, rhetoric against reason counts as about ten to one. The Comtists are reviving—Harrison is coming over to lecture in this country, and much will be made of his brilliant conduct of the controversy. In the next place he has this advantage of you. Your main work bearing upon the issue is to be sought elsewhere, while Harrison had accumulated all the materials of his assault and gives his whole case, so that the popular effect could not fail to be much in his favor. To the narrower circle of readers who can really appreciate the discussion, the republication would undoubtedly be an excellent thing, and I suppose after all it is only these that we should much care for. On the whole it may be politic to reprint. What do you think about it?'

"There was thus raised a quite unexpected problem. I had supposed that the matter had ended with your letter to the *Pall Mall Gazette;* and having expressed (in the *Nineteenth Century*) my intention not to continue the controversy, I hoped it would drop. Here, however, came the prospect of a revival in

another shape; and I had to choose between republication by my American friends or republication by your friends, with the implication that I was averse to it. Though I should have preferred passivity, yet, under the circumstances stated, I thought it best to assent to republication. One objection, however, became manifest. While in my replies to you I had pointed out sundry of your many misrepresentations, I passed over others—one reason being that I could not trespass too much on the space of the *Nineteenth Century* and the attention of its readers. Now, however, when it was proposed that the statements contained in your articles should be re-diffused, and take a permanent form instead of a temporary form, I felt that I could not leave unnoticed these other misrepresentations. Appearing in a volume issued by my American publishers, and edited by my American friend, the implication would have been that statements made by you to which no objection was raised were correct statements. If words in quotation marks tacitly ascribed by you to me had not been disowned by me (p. 112), it would, of course, have been assumed that I had used them, and that I stood convicted of the absurdity which you allege on the assumption that I had used them. If it had not been shown that an opinion you debit me with (p. 129) is wholly at variance with opinions which I have expressed in three different places, it would naturally have been concluded that I held the opinion. Hence it was clear that unless I was to authorize the stereotyping of these and other errors I must take measures to dissipate them. I therefore pointed out to Professor Youmans the statements which required notice, indicated the needful rectifications, and requested him to append these rectifications in his own way. At the same time I forwarded him a copy of the letter which you published in the *Pall Mall Gazette*, saying that 'if this reprint of the articles is published without this letter, he (you) will inevitably say that his final reply has been omitted. It is needful, therefore, that it should be included.' And along with your letter I sent indications of the points in it which should be noticed.

"Do you think I was not justified in this course? Do you think I ought to have withheld my consent to the republication by my friends, leaving your friends to republish? Do you think that, having assented to republication, I ought to have let pass without correction your misstatements previously uncorrected? If you think either of these things, I imagine that few will agree with you. There is, however, an easy way of bringing the question to issue. All the articles are copyright in England, and can not be republished here without the consent of all concerned. I do not suppose that Mr. Knowles will raise any difficulty; and if you agree to the re-issue of them here, I am quite willing that they should be re-issued. If you think that anything said in refutation of your statements should not have been said, we can easily include an appendix in which you can point out this; and then, if you wish it, copies of the volume can be sent round to the press.

"Of course I preserve a copy of this letter with a view to possible future use.

"Faithfully yours, "HERBERT SPENCER.

"Frederic Harrison, Esq."

I will add but two comments. Mr. Harrison had this letter before him when he wrote his statement. Does the reader find that his statement produced an impression anything like that which my letter produces? The other comment is this. Asking whether I have any share in the profits, Mr. Harrison not only by this, but by his title, "A New Form of Literary Piracy," tacitly suggests that

I have. Merely stating that the affair is purely the affair of the Messrs. Appleton, and that not even a thought about money ever entered my head concerning it, I draw attention to the readiness with which Mr. Harrison, without a particle of evidence, makes grave insinuations. And I do this because it will enable the reader to judge what need there probably was for taking the measures I did to prevent the wider and more permanent diffusion of Mr. Harrison's misrepresentations.

Concerning the newspaper extract describing a Comtist service I know nothing, and greatly regret that it was appended. I will at once ask to have it withdrawn. If three gentlemen, appointed in the usual way, decide that under the circumstances, as stated to me by Professor Youmans, I was not justified in the course I took, I will, if Mr. Harrison wishes it, request Messrs. Appleton to suppress the book and destroy the stereotype plates, and I will make good their loss to them.

I am, faithfully yours, HERBERT SPENCER.

May 29.

[*Times, June 2d.*]

MR. SPENCER AND MR. HARRISON.

To the Editor of the Times.

SIR: I will not pursue this matter further, nor will I insist on Mr. Spencer's fair offer to submit it to arbitration. It satisfies me if he will not claim any absolute and moral right to copyright in America my writings with rectifications of his own. I am accustomed to unauthorized reprints of what I write; and as I hear there is a brisk sale for these essays (*quorum pars minima fui*) I will only congratulate the Yankee editor on his 'cuteness. As Mr. Spencer, by his offer, now admits it to be possible that he made a mistake, I am ready to regard his share of it as an inadvertence. I know too well his great generosity in money matters to suppose that any question of profit crossed his mind. But it certainly crossed some one's mind; and I referred to it only to convince him that eager partisans had led him into a mistake. It is not easy at any time to get him to see this, and to open his eyes I used for once plain words. Conscious that I had conducted a philosophical debate with an old friend with all the deference and admiration that I really feel for his genius, it did pain me to find myself treated as the proverbial dog whom any stick is good enough to beat. The only arbitration I now desire is that of some common friend who may convince him that I wish nothing more than a return to the position of philosophic friends who agree to differ about their respective systems.

I am, &c.,

June 1. FREDERIC HARRISON.

[*Times, June 3d.*]

MR. SPENCER AND MR. HARRISON.

To the Editor of the Times.

SIR: Rather than have any further question with Mr. Harrison, and rather than have it supposed that I intentionally ignored his copyright claim, I have telegraphed to Messrs. Appleton to stop the sale, destroy the stock and plates, and debit me with their loss.

I am, faithfully yours,

Clovelly, June 2. HERBERT SPENCER.

[*Times, June 4th*]

MR. SPENCER AND MR. HARRISON.

To the Editor of the Times.

SIR: Allow me to supplement my letter telegraphed yesterday, partly to explain how the thing arose, and partly to correct an impression made by your leader of to-day. I was wrong in assenting to the re-publication by Messrs. Appleton. I ought to have borne passively the threatened evils of re-publication by other publishers, and, as my friend has been connected with publishing in New York for thirty years, I supposed his impression that these were coming was correct. But my decision was made in a hurry, without due thought. Believing there was no time to lose, I telegraphed reply, and by the next post indicated corrections to be made in the statements of my views. And here I wish to point out that the notes I indicated were not criticism of Mr. Harrison's opinions, but corrected versions of my own. Any others, if there are any, are Professor Youmans's. I go on to explain that my mind was so engrossed with the due presentation of the controversy that the question of copyright never occurred to me; and the thought that Mr. Harrison might not like his articles republished was excluded by the impression given me that others would republish them if the Appletons did not. Hence my error. But my error does not, I think, excuse Mr. Harrison's insult. By cancelling the rest of the edition and the plates I have done all that remains possible to rectify the effects of my mistake.

I am, faithfully yours,

Ilfracombe, June 3. HERBERT SPENCER.

[*Times, June 6th.*]

MR. HARRISON AND MR. SPENCER.

To the Editor of the Times.

SIR: May I once more trespass on your space by asking you to publish the following letter from Mr. Harrison?

I am, faithfully yours, HERBERT SPENCER.

"38, Westbourne-terrace, W., June 4, 1885.

DEAR MR. SPENCER: As you still appear to think (in spite of my public disclaimer) that I have brought against you a charge of desiring money profit out of this American reprint, I beg to say that I did not intend to make any such charge, and I do not believe that I have. I regret the use of any words which produced that impression on you.

"I am, yours faithfully, FREDERIC HARRISON.

"P. S.—You can use this letter as you think fit.

"Herbert Spencer, Esq."

[*Standard, June 10th.*]

MR. SPENCER AND MR. HARRISON.

To the Editor of the Standard.

SIR: The fact that the information to which it refers came through *The Standard* must be my excuse for asking you to publish the following letter, a copy of which I have inclosed to Mr. Harrison, requesting him to post it after reading it. I am, Sir, your obedient servant,

HERBERT SPENCER.

"38, Queen's-gardens, Bayswater, London, W., June 9.

"MY DEAR YOUMANS: I returned home last night, and only this morning learned that in *The Standard* of Saturday last there was, in a telegram from New York, a statement to the effect that Messrs. Appleton decline to destroy the stock and plates of the reprinted controversy (as I had telegraphed them to do), on the score that the book would be reprinted by some other publisher. In this expectation they are probably right. But a reprint would necessarily be without the notes; since these, as implied in your preface, are your copyright in America. Now, though these notes—or, at least, those which I pointed out as needful—are corrections of erroneous statements of my views, yet, rather than have it supposed that I wished to take any advantage of Mr. Harrison in making such corrections, I will submit to the evil of re-issue by another publisher without them; and I therefore repeat my request that the stock and stereo plates may be destroyed, and the loss debited to me.

"One word respecting the proposal of the Appletons to share the author's profits between Mr. Harrison and myself. If any have at present accrued, or if, in consequence of refusal to do as I have above requested, any should hereafter accrue, then I wish to say that having been, and being now, absolutely indifferent to profit in the matter, I shall decline to accept any portion of the returns.

"Ever sincerely yours,

"HERBERT SPENCER."

Several points in this correspondence, especially in its opening letter, require some notice in this place; but, before making the critical corrections that seem to be required, I desire to say a few words on the peculiar circumstances of American publication which have an important bearing on the present case.

Mr. Frederic Harrison took offense at the American reprint in a book of some review articles of his, and pronounces it "a case of piracy." The organs of English opinion, in commenting upon these letters, take the same view. The London "Times," after referring to the graceful and honorable termination of the disagreeable difference between Mr. Harrison and Mr. Spencer, devotes a leading editorial to the discussion of American piracy on the basis of the fresh and striking illustration of it here afforded. Speaking of the effect of the "tolerably rigid copyright law" of England, the "Times" says: "But so far as America is concerned it is different. To the English author that country seems to answer very much to Hobbes's idea of a state of nature. Foreign authors are fair prey; for them there is or need be no selling or buying of copyrights, and a good book is to be dealt with as a part of the common elements of nature. If any laws govern the matter, it is only those which regulate the capture and reduction into possession of wild animals." The case is certainly bad enough, but this is an exaggeration.

At the outset I admit that on the question of international copyright, or the claims of foreign authors to property in their books, the English are right and the Americans wrong, so flagrantly wrong as to justify much of the denunciation we receive. The position of our Gov-

ernment upon the subject I regard as wholly indefensible. Its policy is an outrage upon a class of men who are public benefactors, a disgrace to the country, and a scandal to civilization. Grover Cleveland's republic does not recognize that Frederic Harrison and Herbert Spencer have any right of property in the products of their brain-work. Their productions when brought to the United States belong neither to them nor to anybody else. They are not protected by law, and may be appropriated by anybody without violation of law. There are many in this country who realize the vice of this policy quite as vividly as the foreign victims of it, and who are laboring hard to put an end to it. But, without offering a word of apology for it, there is still something to be said in behalf of those who are compelled to act under a bad state of things which they reprobate, but are for the time powerless to remedy. It is certainly unjust to involve these in the indiscriminate condemnation of the vicious system. It is a good deal easier to denounce it at a distance than to fight it on the spot. Nor is it possible for authors, living under a government which so stringently protects them that they acquire the habit of regarding literary property as something peculiarly sacred, to fully appreciate the difficulties of publication and the course which business must take under entirely opposite circumstances, where literary property is without any legal protection. With no international copyright it is certainly impossible to act as if we had one. That the Government does not protect him, and that if protected at all it must be done by himself, is the first and vital fact that has to be taken into account when any publisher makes the venture of reissuing a foreign book in this country. The Government is, in fact, his enemy, and virtually calls upon everybody to make war upon him. However disposed he may be to treat a foreign author well, to bring out his work in respectable shape, and pay him for it fairly, he meets this ugly circumstance at the threshold of the transaction, that the money he puts into it may be sunk because anybody can reprint the work in cheaper form and without paying the author anything. Nor is this all: the more honorable he is, the worse it is for him. Any sense of liberality he may indulge works directly against him. If he publishes the book in good form, pays a decent royalty, and makes it properly known by advertising, all this is a temptation to other parties to take advantage of his outlay, and the reputation the book acquires by means of it, to fill the market with mean editions that kill the honest publication. The American publisher is therefore compelled to adopt a policy very different from that in England, where books are vigilantly and effectively protected by law. He has to conform to the necessities of a lawless state of things, and must be left to make the best he can of it.

But the indiscriminate charges of the London "Times" are not true; all American publishers are not freebooters and pirates. Although it is not possible for them to treat foreign authors with full justice in

the absence of international copyright, yet it is false that these authors are preyed upon in the unqualified way asserted by the "Times." There are, of course, American publishers, and plenty of them, who are thoroughly unscrupulous; but there are others, and they are not a few, who do the best they can under the present demoralizing system to compensate foreign authors for their work. They pay them by voluntary arrangement, not the rates that they are accustomed to at home, and not always perhaps as much as they might, but often, as I happen to know, to their own loss, when books are reprinted by others and the market supplied by degraded editions on which the author receives nothing. In the absence of an international copyright law, this voluntary action of American publishers is the only thing practicable or possible to mitigate the barbarism of the situation. Imperfect as it may be, it is an honest procedure in behalf of the foreign author; and it is now practiced to an extent that should materially qualify those wholesale charges of piracy. The present case is to be regarded in the light of these considerations; and I think it will be found that the lesson to be drawn from it is quite different from that which has been drawn by the English press.

So far as the above correspondence is concerned, the motives that impelled me to take the share I had in bringing out the suppressed book are to be gathered only from a scrap in a hurried private letter to Mr. Spencer; but, as my act is now branded as piratical, I must be excused for stating more fully the reasons by which I was actually influenced in the course taken.

Mr. Harrison had an important controversy with Herbert Spencer on a grave subject, which was published in the "Nineteenth Century." In printing their papers I have the right to assume their purpose to be that they should be read as widely as possible. There was much interest in this country to follow this discussion, and we accordingly printed the articles in "The Popular Science Monthly."

But, when the controversy was finished, there was a call for its republication in a separate form, more convenient, accessible, and cheaper than in the pages of a magazine. The demand was reasonable, and I was anxious to comply with it, that the discussion might be disseminated as widely as possible. I, moreover, desired the republication for the same reason that I had urged Mr. Spencer to go on with the controversy with Mr. Harrison. Although knowing the low state of his working-power, and how important it was that he should not be interrupted by such side-issues in the prosecution of the great philosophical work upon which he has been engaged for many years, it seemed to me of greater importance that he should seize the opportunity offered by Mr. Harrison's attack to develop more fully his fundamental religious opinions. He had published but little upon that subject for a long time, his views had been much controverted and much misunder-

stood, and I knew there was a strong desire on the part of many to read everything he might say in further interpretation and elucidation of them. His distinctive doctrines were now vigorously and formally attacked by a sagacious adversary, long prepared by his special studies to put them to the severest test. For the same reason that I encouraged Mr. Spencer to give time to the discussion, I desired that his readers in this country should be put in ready possession of it when done. I may add that in this I was impelled by the same general motives that had prompted me for many years to do what I could to bring Mr. Spencer's ideas before the American people.

But there were special reasons which made me wish that the publication should be issued by D. Appleton & Co. This house had printed all of Spencer's works; and as a present statement of his religious views would be an important addition to them, and would naturally be called for in connection with them, it seemed important that his controversy with Harrison should be brought out in a reputable and permanent shape to take its place with his other books. Besides, there was a high degree of certainty that the discussion would be published by somebody. The names of the eminent contestants, and the interest felt by a large number of people in the subject, were evineed by a strong demand for the publication. The discussion in its separate form was called for by the friends of Mr. Harrison and by the friends of Mr. Spencer, and by others who were friends of neither. It was open to anybody to print it, and there was every probability that it would be picked up and issued in a cheap, catchpenny edition, which is now so common with publications of every kind. I desired, therefore, that the Appletons should bring it out in a respectable shape, and at a moderate price, that the book might be had at any time in a form suitable for preservation.

I protest that these considerations were not vitiated by any covetous desire or purpose whatever. Mr. Harrison says it is a case of "piracy"; but, so far as this involves the taking of his property without compensation, there was no thought of it. In his opening letter he virtually accused Mr. Spencer of collusion in the piracy of his articles, from a sordid intention. Judged by this extraordinary letter, Mr. Harrison's religion of humanity consists chiefly in imputing vile motives to his fellow-men. He said, "May I ask if it is proposed to hand you the profits of a book of which I am (in part) the author, or are these to be retained by your American publishers and friend?" Evidently the pecuniary consideration was uppermost in his own mind. But he had here gone too far. Everybody recognized the outrage. The reader will note the striking difference in tone, amounting to a collapse, between his first and his second letters. He withdrew the offensive insinuation so far as Mr. Spencer was concerned, saying, "I know too well his great generosity in money matters to suppose that any question of profit crossed

his mind." But he knew this no better when he wrote his second letter than when he wrote the first. He sent Mr. Spencer a private note asking explanations about the book, and this Mr. Spencer answered, but said nothing respecting the copyright; this did not enter his mind, probably for the reason that the house which issued it had published his books for twenty-five years, paying him regularly on all of them from the first, and he had no care about it, knowing that the equitable thing would of course be done to all concerned. But the inadvertence gave Harrison his opportunity.

But while Mr. Harrison exonerates Mr. Spencer from all thought of making profit out of him, he adds, "But it certainly crossed some one's mind," referring of course to Mr. Spencer's "American publishers and friend." Yet there was not the slightest wish or design on the part of the publishers of the book to withhold from Mr. Harrison his proper share in its copyright proceeds. They have published the scientific and philosophical works of many English authors, on which they have paid the customary compensation allowed to American authors, and if Mr. Harrison doubts it he can satisfy himself by inquiring of his neighbors, Tyndall, Lecky, Huxley, Bain, Sully, or the Darwins, and there is surely no reason why they should not have compensated Mr. Harrison in the same way; and this was certainly their intention.

But perhaps the party who desired to plunder Mr. Harrison (he uses the significant word twice in his first letter) was Mr. Spencer's American friend, and that he supposed this "friend" capable of sharp practice is inferable from his remark, "I will only congratulate the Yankee editor on his 'cuteness." Yet the 'cute Yankee editor in this case was the only party to get nothing. Among the several stools occupied by authors and publishers, it was his fate to sit on the ground. Neither by stipulation nor expectation was he to have a cent for his labor in editing the volume, or his efforts in promoting its circulation. The reasons which actuated him have been already stated. But as the question is here raised of venal motives in the treatment of foreign authors, and as this transaction has been extensively paraded as a flagitious example of American piracy, the editor of the suppressed book is entitled to say that he has done his full share in a practical way toward promoting international equity in the payment of authors for their books. He gave nearly a year's labor to the organization of the "International Scientific Series" for the avowed purpose of securing more satisfactory compensation to scientific writers. The project was based upon the condition of the payment of copyright to each of the contributors from all the countries in which the books were issued. Nothing of the kind had ever been done or attempted before; and, in regard to its result, Dr. John W. Draper remarked, "Although there are international copyright regulations in Europe, and my various works have been translated into many foreign

languages, I have never received anything from them except upon the volume I wrote for the 'International Series,' and on that I have been paid regularly by the English, French, German, and Italian, as well as by the American publishers." Fifty volumes have now appeared in that series, and the American publishers have voluntarily paid all the foreign contributors the same as if they had been citizens of the United States. And this they have done in spite of the fact that this honorable arrangement has been disregarded, and various of the volumes have been reprinted in shabby twenty-cent editions, on which, of course, the authors have received nothing.

This, then, is the way in which Mr. Harrison has been outraged. He had his articles brought out in good shape for such of his friends as desired to possess them in a separate form. He has been "plundered" by being protected against plunder on the part of those who might have issued a trivial and fugitive edition of his controversy, and allowed him nothing for it. He has been "pirated" by having voluntarily secured for him the substantial benefits of an international copyright law.

But Mr. Harrison's articles were used without his consent, and that is what the charge of "piracy" here amounts to. His consent was not asked, because it would have implied control of that over which he had no control. If he had refused, that would not have stopped the publication, but would have simply defeated the purposes of those who knew better than Mr. Harrison did what required to be done. He was not consulted for the simple reason, now obvious enough, that he would be unlikely to make allowance for a state of things utterly different from that to which he has been accustomed. He was not asked, because, while his assent would have done no good, his dissent would have done injury to himself, to Mr. Spencer, and to the public. And that Mr. Harrison would have withheld his consent is far from improbable. That the book was wanted here by many readers was nothing to him, as is shown by the fact that, when a word would have saved it from destruction, he declined to utter it. Something is of course due to courtesy, but I was not at all certain that courtesy would be met in the same spirit. The feeling of high-toned British authors toward American "pirates" is not usually vented in gracious expression. American experience with such authors is apt to engender diffidence in approaching them. Those gentlemanly and honorable publishers, the Messrs. Putnam, having special reasons recently to make overtures to Mr. Ruskin for the use of one of his articles (to be paid for, of course), were deterred from doing so because that author "absolutely declined to come into any relation with an American publisher." Mr. Harrison is understood to be a particular and punctilious man, and that he can, upon occasion, pretermit the requirements of amiable civility, and take to "plain words," is amply attested by his letter of May 29th to Herbert Spencer.

But, in the matter of "piracy," it is Mr. Spencer who comes in for Harrison's hottest indignation. He accuses him of having invented a new form of it, and aggravated the offense by its clandestine perpetration. Now, let us see what it was that Spencer did. After finishing the controversy in the "Nineteenth Century," Mr. Harrison transferred it to the "Pall Mall Gazette," in which he printed an additional article, addressed to a new audience, and filled with very objectionable misstatements. It would not do, in editing the volume which was intended to be a full presentation of the discussion, to leave this article out. But to print it without corrections would be unjust to Spencer, and to the readers of the book, who wanted and were entitled to the completest statement of the case. There was no call for anything more from Mr. Harrison, who had had his last word, and declared that he should pursue the controversy no further; but there *was* a need that corrections by Spencer should be supplied. He accordingly sent me the substance of some additions to be appended as notes, and which I inserted in their appropriate places. I deny the wrongfulness of this act, and the ado that has been made over it seems to me perfectly absurd. Mr. Spencer did what it was desirable and entirely proper that he should do. He had not only the right but it was his duty to defend himself against the erroneous representations of Mr. Harrison; and I insist that, if any apology was due either way, it was from Mr. Harrison to Spencer for making the misstatements, rather than from Spencer to Harrison for correcting them.

Mr. Spencer, as will be seen, prints two paragraphs from a private letter of mine giving reasons which induced him to favor the American reprint, and Mr. Harrison characterizes them as chiefly "inventions." I had said, "Harrison is coming over to lecture in this country," and Mr. Harrison says he never thought of it. I wrote carelessly; but my meaning was, that he is *expected* to come, and in this there was no "invention." It had been talked about, and there was nothing unlikely in it. The coming of eminent Englishmen to this country to lecture is certainly no unusual thing. Mr. Harrison is a lecturer, a man of ideas which he is interested in propagating, and is reputed to have means and leisure. He has many admirers in the United States, and a reputation which would be certain to secure him good audiences. As it turns out, "the wish was father to the thought," but the rumor was not improbable. I should have referred to it as a contingency, and I simply meant that it might be worth taking into account, with reference to the publication of the controversy.

Mr. Harrison says the idea that there was any danger of republication in this country by his friends rested also upon pure "invention." But I did not say this. I wrote to Spencer, "There is danger that it will be done by others, and if that should occur it would be construed as a triumph of the Harrison party." Mr. Spencer's interpretation of it was, "I had to choose between republication by my American

friends or republication by your friends, with the implication that I was averse to it." And Mr. Spencer was here substantially right. Although there may have been no apprehension that Mr. Harrison's avowed friends would move in reprinting the book, yet, if it had been done by anybody but the Appletons, the inevitable inference would have been that their author had been so badly handled that they declined to back him. The book was looked for from Mr. Spencer's publishers, they had printed it in their magazine, they issued all his works, there was a demand for the volume which was certain to make it a safe business venture, and it represented two sides or schools of thought: if, under all these circumstances, D. Appleton & Co. had left the work for others to publish, the certain construction would have been that the book was abandoned to the party opposed to Mr. Spencer. This is the aspect of the case which he had to meet, and it is not at all affected by Mr. Harrison's statement that his friends had no idea of printing the controversy.

Another explanation seems here called for. Those who will refer to the second paragraph of my letter, quoted by Mr. Spencer, will observe both an indecision and a confusion in the statement. This was due, not only to hasty writing, but to some perplexity in my own mind. I said, "If I thought no one else would print the correspondence" (controversy), "I should be in favor of our not doing it"; and I then go on to give reasons for this conclusion, ending with the remark, "On the whole, it may be politic to reprint." Apparently this indifference to publication is inconsistent with the various reasons I have given for strongly desiring it. But there was a consideration not mentioned in the letter which weighed much with me at the time. I was in very bad health, and was urged by physicians and friends to go South without delay. It seemed therefore to be impracticable, if not impossible, for me to give that attention to the editing and publication of the volume which were prompted by my interest in it. But it will be noticed that, under this conflict of inclinations, though I gave some trivial reasons for non-publication, the conclusion favors reprinting. This shows the predominant feeling, even in a time of depression; and I must say, as a matter of fact that, though referring the matter as I did in a hurried note to Mr. Spencer, I had not for a moment really relinquished the purpose of bringing out the book. This explanation is necessary, that the responsibility may rest where it properly belongs. Mr. Harrison lays stress upon Spencer's agency in "promoting and assisting" in the production of "a volume for which you are responsible, and which you have authorized and adopt." But though Mr. Spencer chose to take the responsibility because he had assented to it, and furnished some notes for it, yet it was neither by his suggestion, procurement, nor desire that the book was issued; and truth requires me here to say that, if he had discouraged or even opposed it, the book would probably have been reprinted by D. Appleton &

Co. all the same. Mr. Spencer had, in reality, very little to do with the edition. For the Introduction, the bad taste with which the notes were embellished, and the newspaper quotation describing the doings in a branch of the positivist church in London which Mr. Harrison does not like, he is not to be held to account.

For his offense in correcting some injurious misrepresentations in a controversial volume published for the use of a people three thousand miles away, the London "Times" declares that Mr. Spencer has made the *amende honorable* by destroying the book; and this is the general English view. The equally general American view is, that this extreme proceeding was ridiculous, that it benefited nobody, and gratuitously deprived many readers in this country of a valuable work on an important subject. It is, at any rate, desirable that the responsibility for this result should be fixed where it justly belongs. Mr. Spencer made two proposals to Harrison looking to the preservation of the work, both of which were absolutely fair, but neither of which was accepted. Mr. Spencer would have been justified in making a stand upon either of these propositions, and refusing further concessions; but Mr. Harrison's rejection of his overtures left the matter in so unsatisfactory a shape that nothing remained for Mr. Spencer but to cut the knot by ordering the book suppressed.

GENIUS AND INSANITY.

By JAMES SULLY.

THE problems which have so long perplexed the thoughtful mind in presence of that dark yet fascinating mystery, the nature and origin of genius, have recently propounded themselves with new stress and insistence. Whatever may be said against Mr. Froude's neglect of the pruning-knife in publishing Carlyle's "Journals and Letters," the psychologist at least will be grateful to him for what is certainly an unusually full and direct presentment of the temperament and life of genius. Here we may study the strange lineaments which stamp a family likeness on the selected few in whose souls has burned the genuine fire of inspiration. These memoirs disclose with a startling distinctness the pathetic as well as the heroic side of the great man. In Carlyle we see the human spirit in its supreme strength jarred and put out of tune by the suffering incident to preternaturally keen sensibilities and an unalterably gloomy temperament.

In this strange record, too, we find ourselves once more face to face with what is perhaps the most fascinating of the fascinating problems surrounding the subject of intellectual greatness, that of its relation to mental health. Carlyle compels the attentive reader to propound to himself anew the long-standing puzzle, "Is genius something

wholly normal and sane?" For there is surely a suggestion of temporary mental unsoundness in the idea of that lonely wanderer through the crowded streets of London suddenly seeing in the figures he met so many specters, and feeling himself to be but another "ghastly phantom haunted by demons." And, if all anger is a sort of madness, it is but natural that one should see something of a momentary mania in those terrible outbursts of a spirit of revolt against all things which now and again made desolate the Chelsea home, and wrung from the sage's wife the humiliating confession that she felt as if she were "keeper in a madhouse."

The idea that there is an affinity between genius and mental disease seems at first foreign to our modern habits of thought. In the one, we have human intellect rejoicing in Titanic strength; in the other, that same intellect disordered and pitiably enfeebled. Yet, as has been hinted, the belief in the connection of the two is an old and persistent one. In truth, the common opinion has always gravitated toward this belief. A word or two may make this clear.

To the multitude of men genius wears a double aspect. Superlative intellectual endowment is plainly something very unlike the ordinary type of intelligence. The relation of lofty superiority includes that of distance, and mediocrity in viewing the advent of some new spiritual star may adopt either the one or the other *manière de voir*. Which aspect it will select for special contemplation depends on circumstances. In general it may be said that, since the recognition of greatness presupposes a power of comprehension not always granted to mediocrity, the fact of distance is more likely to impress than the fact of altitude. It is only when supreme wisdom has justified itself, as in the predictions of the true prophet, that its essential rightness is seen by the crowd. Otherwise the great man has had to look for recognition mainly from his peers and the slightly more numerous company of those whose heads rise above the mists of contemporary prejudice.

It is easy to see that this vulgar way of envisaging genius as marked divergence from common-sense views of things may lead on to a condemnation of it as a thing unnatural and misshapen. For, evidently, such divergence bears a superficial likeness to eccentricity. Indeed, as has been well said, the original teacher has this much in common with the man mentally deranged, that he "is in a minority of one"; and, when pains are not taken to note the direction of the divergence, originality may readily be confounded with the most stupid singularity; and, further, a cursory glance at the constitution of genius will suffice to show that the originator of new and startling ideas is very apt to shock the sense of common men by eccentricities in his manner of life. A man whose soul is being consumed by the desire to discover some new truth, or to give shape to some new artistic idea, is exceedingly liable to fall below the exactions of conventional society

in the matter of toilet and other small businesses of life. Among the many humorously pathetic incidents in the records of great men, there is perhaps none more touching than the futile attempt of Beethoven to dress himself with scrupulous conformity to the Viennese pattern of his day.

In contradistinction to this disparaging view, the admiring contemplation of the great man as towering above minds of ordinary stature seems directly opposed to any approximation of the ideas of genius and mental disorder. And this has undoubtedly been in the main the tendency of the more intelligent kind of reverence. At the same time, by a strange, eddy-like movement in the current of human thought, the very feeling for the marvelousness of genius has given birth to a theory of its nature which in another way has associated it with mental aberration. I refer to the ancient doctrine of inspiration as developed more particularly in Greece.

It may be worth while to review for a moment the general course of thought on this dark subject.

In the classic world, preternatural intellectual endowments were, on the whole, greeted with admiration. In Greece more particularly, the fine æsthetic sense for what is noble, and the quenchless thirst for new ideas, led to a revering appreciation of great original powers.* The whole manner of viewing such gifts was charged with supernaturalism. As the very words employed clearly indicate, such fine native endowment was attributed to the superior quality of the protective spirit (δαίμων, genius) which attended each individual from his birth. We see this supernaturalism still more plainly in the Greek notion of the process of intellectual generation. The profound mystery of the process, hardly less deep than that of physical generation, led to the grand supposition of a direct action of the Deity on the productive mind. To the Greeks the conception of new artistic ideas implied a possession (κατοχή) of the individual spirit by the god.

Now, it might naturally occur to one that such an inundation of the narrow confines of the human mind by the divine fullness would produce a violent disturbance of its customary processes. It was a shock which agitated the whole being to its foundation, exciting it to a pitch of frenzy or mania. The poet was conceived of as infuriated or driven mad by the god; and a somewhat analogous effect of divine intoxication was recognized by Plato as constituting the essence of philosophic intuition.† Hence Greek and Roman literature abounds with statements and expressions which tend to assimilate the man of genius to a madman. The "furor poeticus" of Cicero and the "amabilis insania" of Horace answer to the θεῖα μανία of Plato. And to

* Socrates is perhaps only an apparent exception, for the odium he excited seems to have been due to the essentially critical and destructive character of his mission.

† See the memorable passage in the "Phædrus," p. 244 A, etc. Plato went so far as to suggest that the name μάντις, seer, was derived from μαίνομαι, to rage or be mad.

the more scientific mind of Aristotle it appeared certain (according to Seneca) that there was no great intellect (*magnum ingenium*) without some mixture of madness (*dementiæ*).

It must be remembered, however, that in the eyes of the ancients genius was hardly degraded by this companionship with madness. Men had not yet begun to look on insanity as one of the most pitiable of maladies. So far from this, it was a common idea that the insane were themselves inspired by the action of deity. We have a striking illustration of the absence even among the educated Greeks of the modern feeling toward madness in the fact that Plato was able to argue, with no discoverable trace of his playful irony, that certain sorts of madness are to be esteemed a good rather than an evil.*

The influence of Christianity and of the Church served at first to brand mental derangement with the mark of degradation. The doctrine of possession now assumed a distinctly repellent form by the introduction of the Oriental idea of an evil spirit taking captive the human frame and using it as an instrument of its foul purposes. The full development of this idea of demoniacal possession in the middle ages led, as we know, to many cruelties. And, though Christianity showed its humane side in making provision for the insane by asylums, the treatment of mental disease during this period was, on the whole, marked by much harshness.†

This debasement of the idea of madness had, however, no appreciable effect in dissolving the companionship of the two ideas in popular thought. For the attitude of the Church was, for the most part, hostile to new ideas, and so to men of original power. In sooth, we know that they were again and again branded as heretics, and as wicked men possessed by the devil. And thus genius was attached to insanity by a new bond of kinship.

The transition to the modern period introduces us to a new conception both of genius and of insanity. The impulse of inquisitiveness, the delight in new ideas, aided by the historical spirit with its deep sense of indebtedness to the past, have led the later world to extol intellectual greatness. We have learned to see in it the highest product of Nature's organic energy, the last and greatest miracle of evolution. On the other hand, the modern mind has ceased to see in insanity a supernatural agency, and in assimilating it to other forms of disease has taken up a humane and helpful attitude toward it.

Such a change of view might seem at first to necessitate a sharp severance of the new ideas. For, while it places genius at the apex of

* "Phædrus," *loc. cit.* Mr. Lecky points out that the Greeks had no asylums for the insane ("History of European Morals," vol. ii, p. 90). On the other hand, Dr. Maudsley tells us that Greek scientific opinion on the subject was an anticipation of modern ideas ("Responsibility in Mental Disease," p. 6).

† See Lecky, *op. cit.*, vol. ii, p. 92, etc.; cf. Maudsley, *op. cit.*, p. 10.

evolution, it reduces madness to a form of disintegration and dissolution. Nevertheless, we meet in modern literature with an unmistakable tendency to maintain the old association of ideas. Genius is now recognized as having a pathological side, or a side related to mental disease. Among our own writers we have so healthy and serene a spirit as Shakespeare asserting a degree of affinity between poetic creation and madness:

> "The lunatic, the lover, and the poet,
> Are of imagination all compact," etc.
> *Midsummer-Night's Dream*, act v, sc. 1.

A more serious affirmation of a propinquity is to be found in the well-known lines of Dryden:

> "Great wits are sure to madness near allied,
> And thin partitions do their bounds divide." *

As might be expected, French writers, with their relish for pungent paradox, have dealt with special fullness on this theme. "Infinis esprits," writes Montaigne on a visit to Tasso in his asylum, "se trouvent ruinez par leur propre force et soupplesse." Pascal observes that "l'extrême esprit est voisin de l'extrême folie." In a similar strain Diderot writes: "Oh! que le génie et la folie se touchent de bien près!" The French writer who most distinctly emphasizes the proposition is Lamartine. "Le génie," he observes in one place, "porte en lui un principe de destruction, de mort, de *folie*, comme le fruit porte le ver"; and again he speaks of that "maladie mentale" which is called genius.

In German literature it is Goethe, the perfect ideal, as it would seem, of healthy genius, who dwells most impressively on this idea. His drama, "Tasso," is an elaborate attempt to uncover and expose the morbid growths which are apt to cling parasitically about the tender plant of genius. With this must be mentioned, as another striking literary presentment of the same subject, the two eloquent passages on the nature of genius in Schopenhauer's *opus magnum*.

Against this compact consensus of opinion on the one side we have only a rare protest like that of Charles Lamb on behalf of the radical sanity of genius.† Such a mass of opinion can not lightly be dismissed as valueless. It is impossible to set down utterances of men like Diderot or Goethe to the envy of mediocrity. Nor can we readily suppose that so many penetrating intellects have been misled by a passion for startling paradox. We are to remember, moreover, that this is not a view of the great man *ab extra*, like that of the vulgar already referred to; it is the opinion of members of the distinguished fraternity themselves who are able to observe and study genius from the inside.

* "Absalom and Achitophel," part i, line 163.

† See his essay, "Sanity of True Genius," in the "Last Essays of Elia."

Still, it may be said, this is, after all, only unscientific opinion. Has Science, with her more careful method of investigating and proving, anything to say on this interesting theme? It is hardly to be supposed that she would have overlooked so fascinating a subject. And, as a matter of fact, it has received a considerable amount of attention from pathologists and psychologists. And here for once Science appears to support the popular opinion. The writers who have made the subject their special study agree as to the central fact that there is a relation between high intellectual endowment and mental derangement, though they differ in their way of defining this relation. This conclusion is reached both inductively by a survey of facts, and deductively by reasoning from the known nature and conditions of great intellectual achievement on the one hand, and of mental disease on the other.*

What we require first of all is clearly as many instances as can be found of men of genius who have exhibited intellectual or moral peculiarities which are distinctly symptomatic of mental disease. Such a collection of facts, if sufficient, will supply us with a basis for induction. In making this collection we need not adopt any theory respecting the nature either of genius or of mental disease. It is sufficient to say that we include under the former term all varieties of originative power, whether in art, science, or practical affairs. And as to the latter term, it is enough to start with the assumption that fully developed insanity is recognizable by certain well-known marks; and that there are degrees of mental deterioration, and a gradual transition from mental health to mental disease, the stages of which also can, roughly at least, be marked off and identified.

In surveying the facts which have been relied on by writers, we shall lay most stress on mental as distinguished from bodily or nervous symptoms. And of these we may conveniently begin with the less serious manifestations:

1. The lowest grade of mental disturbance is seen in that temporary appearance of irrationality which comes from an extreme state of "abstraction" or absence of mind. To the vulgar, as already hinted, all intense preoccupation with ideas, by calling off the attention from outer things and giving a dream-like appearance to the mental state, is apt to appear symptomatic of "queerness" in the head. But in order that it may find a place among distinctly abnormal features this absence of mind must attain a certain depth and persistence. The ancient story of Archimedes, and the amusing anecdotes of Newton's

* The principal authoritative utterances on the subject are Moreau, "La Psychologie morbide," etc.; Hagen, "Ueber die Verwandtschaft des Genies mit dem Irresein" ("Zeitschrift für Psychiatrie," Band 33); and Radestock, "Genie und Wahnsinn (Breslau, 1884). This last contains the latest review of the whole question, and is written in a thoroughly cautious scientific spirit. I have derived much aid from it in preparing this essay.

fits, if authentic, might be said perhaps to illustrate the border-line between a normal and an abnormal condition of mind. A more distinctly pathological case is that of Beethoven, who could not be made to understand why his standing in his night attire at an open window should attract the irreverent notice of the street boys. For in this case we have a temporary incapacity to perceive exterior objects and their relations; and a deeper incapacity of a like nature clearly shows itself in poor Johnson's standing before the town clock vainly trying to make out the hour.

This same aloofness of mind from the external world betrays itself in many of the eccentric habits attributed to men and women of genius. Here, again, Johnson serves as a good instance. His inconvenient habit of suddenly breaking out with scraps of the Lord's Prayer in a fashionable assembly marks a distinctly dangerous drifting away of the inner life from the firm anchorage of external fact.

In the cases just considered we have to do with a kind of mental blindness to outer circumstances. A further advance along the line of intellectual degeneration is seen in the persistence of vivid ideas, commonly anticipations of evil of some kind, which have no basis in external reality. Johnson's dislike to particular alleys in his London walks, and Madame de Staël's *bizarre* idea that she would suffer from cold when buried, may be taken as examples of these painful delusions or *idées fixes*. A more serious stage of such delusions is seen in the case of Pascal, who is said to have been haunted by the fear of a gulf yawning just in front of him, which sometimes became so overmastering that he had to be fastened by a chain to keep him from leaping forward.

It is plain that in this last case we touch on the confines of sense-illusion. It is probable that hallucinations may occur as very rare experiences in the case of normal and healthy minds. Yet, though not confined to states of insanity, illusions of the senses are commonly, if not always, indicative of at least a temporary disturbance of the psycho-physical organism. And we have on record a considerable number of instances of eminent men who were subject to these deceptions. It is not only the religious recluse, with his ill-nourished body, and his persistent withdrawal from the corrective touch of outer things, who experiences them. Luther was their victim as well as Loyola. Auditory hallucinations—that is, the hearing of imaginary voices—appear to have occurred to Malebranche and Descartes, as they certainly did to Johnson. The instances of visual hallucinations are perhaps more numerous still. Pope, Johnson, Byron, Shelley, are said to have had their visions. Even so strong and well-balanced a mind as Goethe was not exempted. Nor has the active life of the soldier always proved a safeguard. The stories of the prognostic visions of Brutus and other generals of the old world are well known. Among

modern ones, Napoleon is said to have had recurring visits from his guardian spirit or genius.

In the abnormalities just touched on, disturbance of intellectual function is the chief circumstance, though an element of emotional disturbance is commonly observable as well. In another class of cases this last ingredient becomes the conspicuous feature. By this is meant such an accession of general emotional excitability, and along with this such a hypertrophy and absolute ascendency of certain feelings, as to constitute a distinct approximation to the disorganized psychical state which has been called moral insanity.

And here reference may first be made to that violence of temper and that extravagant projection of self and its concerns to the displacement of others' claims and interests which might be termed a kind of moral hallucination. How many names in the roll of English writers at once occur to the mind in this connection! Pope, Johnson, Swift, Byron, to which list must now be added Carlyle, may be taken as typical instances of the *genus irritabile vatum*. And among foreign deities we have Voltaire and Rousseau, Handel and Beethoven, and even philosophers like Herder and Schopenhauer.

Other emotional disorders take on more distinctly the aspect of moral obliquities. And here we have specially to do with poetic genius. Without adopting the slightly contemptuous opinion that poets are, as a rule, a "sensuous, erotic race," one must admit that an untamed wildness of amatory passion has been a not infrequent accompaniment of fine poetic imagination.*

For a clear illustration, however, of the morbid tendency of such irregularities, we must go, not to the comparatively regular life of a Goethe or a Shelley, but to the wild and lawless career of a Rousseau, of whom it was well said by a clever woman, "Quand la Nature forma Rousseau, la sagesse pétrit la pâte, mais la folie y jeta son levain."

To a tempestuous violence of sexual passion there has too commonly joined itself a feverish craving for physical stimulants;† and so the pure heavenly flame of genius has again and again had to contend with the foul, murky vapors which exhale from the lower animal nature. No need to tell again the gloomy story of splendid power eaten into and finally destroyed by the cancer of rampant appetite. In our own literature the names of Ben Jonson, Nat Lee, Burns, and others at once occur to the student. Edgar Allan Poe represents the same tragic fatefulness of genius in American letters. Among Frenchmen we have as conspicuous examples Villon and De Musset. Among Germans, Günther, Bürger, and numbers of those about Herder and

* Even the spiritual Dante has been found wanting in this matter by no more strait-laced an authority than Boccaccio.

† These include not only alcoholic drinks but opium, to the use of which Voltaire, Madame de Staël, Coleridge, and De Quincey, and probably others, were addicted. The excitement of gambling seemed in Lessing's case to fill the place of physical stimulants.

Goethe in the turbulent times of the *Sturm und Drang*, and Hoffmann, the novelist, suffered the same moral shipwreck.

2. We may now pass to another class of cases in which the pathological character is still more plainly discernible. Outbursts of fierce passionateness may perhaps be thought by some to be, after all, only marks of a certain kind of robust vitality. But no one will say this of the gloomy depression, the melancholy brooding on personal ills, ending sometimes in distinctly hypochondriac despondency, which have not unfrequently been the accompaniment of great intellectual power. It was remarked by Aristotle, who was a long way the shrewdest and most scientific observer of antiquity, that all men of genius have been melancholic or atrabilious.* He instances Empedocles, Socrates, and Plato, and the larger number of the poets. And the page of modern biographic literature would supply many a striking illustration of the same temperament. The pessimism of Johnson, Swift, Byron, and Carlyle, of Schopenhauer and Lenau, of Leopardi and of Lamartine, may perhaps be taken as a signal manifestation of the gloom which is apt to encompass great and elevated spirits, like the mists which drift toward and encircle the highest mountain-peaks.

In some cases this melancholy assumes a more acute form, giving rise to the thought and even the act of suicide. Among those who have confessed to have experienced the impulse may be mentioned Goethe in the Werther days, Beethoven during the depression brought on by his deafness, Chateaubriand in his youth, and George Sand also in her early days. The last, writing of her experience, says, "Cette sensation" (at the sight of water, a precipice, etc.) "fut quelquefois si vive, si subite, si bizarre, que je pus bien constater que c'était une espèce de folie dont j'étais atteinte." Johnson's weariness of life was, it seems certain, only prevented from developing into the idea of suicide by his strong religious feeling and his extraordinary dread of death, which was itself, perhaps, a morbid symptom.

In some cases this idea prompted to actual attempts to take away life. The story of Cowper's trying to hang himself, and afterward experiencing intense religious remorse, is well known. Another instance is that of Saint-Simon, whose enormous vanity itself looks like a form of monomania, and who, in a fit of despondency, fired a pistol at his head, happily with no graver result than the loss of an eye. Alfieri, who was the victim of the "most horrid melancholy," tried on one occasion, after being bled by a surgeon, to tear off the bandage in order to bleed to death. Among those who succeeded in taking away their life are Chatterton, whose mind had been haunted by the idea from early life, Kleist the poet, and Beneke the philosopher.

* "Cur homines qui ingenio claruerunt vel in studiis philosophiæ, vel in republicâ administrandâ, vel in carmine pangendo, vel in artibus exercendis, melancolicos omnes fuisse videamus?" *Prob.* xxx. Aristotle's authority on the point is quoted by Cicero, *Tuscul. disp.*, i, 33; *de divin.*, i, 38.

3. We may now pass to the most important group of facts—namely, instances of men of genius who have suffered from fully developed mental disease.

In certain cases this disruption of the organs of mind shows itself in old age, and here, it is evident, we have to distinguish what is known as senile dementia from the impairment of faculty incident to old age. A clear instance of cerebral disease is afforded by the botanist Linnæus, whose faculties gave way after a stroke. The mental stupor into which the poet Southey finally sank was a similar phenomenon. Swift's fatal disease, the nature of which has only recently been cleared up by science, was cerebral disorganization brought on by peripheral disease in the organ of hearing. Zimmermann, the author of the work on "Solitude," who had been a hypochondriac from the age of twenty, ended his life in a state of melancholy indistinguishable from insanity. The final collapse, under the pressure of pecuniary anxieties, of Scott's cerebral powers, is too well known to need more than a bare mention.

Besides these instances of senile collapse, there are several cases of insanity showing itself in the vigorous period of life. Sometimes, as in the instance of Richelieu, who had shown himself an erratic being from his childhood, the madness appeared as a sudden and transient fit of delirium. In other cases the disorder took a firmer hold on the patient. Charles Lamb, Handel, and Auguste Comte suffered from insanity for a time, and had to be put under restraint. Tasso, whose whole nature was distinctly tinged with the "insane temperament," had again and again to be confined as a madman. Donizetti was also for a time insane and confined in an asylum. Among those who became hopelessly insane were the poets Lenau and Hölderlin and the composer Schumann, the latter of whom had long been the victim of melancholy and hallucinations, and had before his confinement attempted to drown himself in the Rhine.

I have preferred to dwell on the physical aspect of the relation between genius and disease. But no adequate investigation of the subject is possible which does not consider the physical aspect as well. No one now, perhaps, really doubts that to every degree of mental disturbance and mental disorganization there corresponds some degree of deterioration and disorganization of the nerve-centers. Psychical disturbance and disruption proceed *pari passu* with physical.

This being so, it is pertinent to our study to remark that men of genius have in a surprising number of cases been affected by forms of nervous disease which, though not having such well-marked psychical accompaniments as occur in states of insanity, are known to be allied to these.

4. To begin with, it seems certain that a number of great men have died from disease of the nerve-centers. Among other names may be mentioned Pascal, who had all his life been the victim of nervous

disorders, and who succumbed, at the early age of thirty-nine, to paralysis accompanied by convulsions. Two of the greatest scientific men, Kepler and Cuvier, died, according to Moreau, from disease of the brain. Rousseau was carried off by an attack of apoplexy. Mozart's early death was due to brain-disease, showing itself in other ways by morbid delusions, fainting-fits, and convulsions. Another musician, Mendelssohn, succumbed to an attack of apoplexy. Heine's fatal malady, which kept him for seven years a prisoner in his "mattress-grave," was disease of the lower nerve-centers in the spinal cord.

Other men of genius have suffered from nervous disorders from time to time. Molière was the subject of recurring convulsions, an attack of which would prevent his working for fifteen days. Alfieri, to whose morbid mental symptoms reference has already been made, suffered when young from a disease of the lymphatic system, and was afterward liable to convulsions. Paganini, the musician, suffered from an attack of catalepsy when four years old, and later on was the victim of recurring convulsions; and Schiller, who was very delicate from youth, was also the subject of recurring fainting-fits and convulsions.

The lesser forms of nervous disorder—headache, *malaise*, and recurring periods of nervous prostration—are too common among all brain-workers to call for special notice here. The latest biography of a woman of genius strikingly illustrates this milder form of the penalty which mortals have to pay for daring to aspire to the ranks of the immortals. In George Eliot we have one more name added to the list of great ones to whom, to use the words of a French writer, has been granted "le funeste privilège d'entendre crier à toute heure les ressorts de leur machine."

5. One other significant group of facts remains to be touched on. In a considerable number of cases it has been ascertained that insanity or other form of nervous disorder has shown itself in the same family as genius, whether as its forerunner, companion, or successor. Chateaubriand's father is said to have died of apoplexy. Schopenhauer's grandmother and uncle were imbecile. Several distinguished men had insane sisters, among others Richelieu, Diderot, Hegel,* and Charles Lamb. One of Mendelssohn's sons became insane.†

I have endeavored in this brief review of the alleged facts to give an adequate impression of their variety and range. It now remains to inquire into their precise evidential value.

The first question that naturally arises here is whether the facts are well authenticated and accurately presented. A cautious mind will readily reflect that if genius as such is apt to assume an abnormal aspect to average common sense, biographers may easily have invent-

* That Hegel's sister was insane and drowned herself is asserted by Moreau, on the authority of an article in the "Revue des Deux Mondes," and quoted by Radestock.

† Symptoms of insanity are said by Moreau to have shown themselves in the families of several eminent rulers, including Peter the Great. (See Radestock, p. 4, *seq.*)

ed, or at least exaggerated, some of the alleged morbid characteristics of the great; and as a matter of fact there is good reason to suppose that this falsifying of the record of greatness has taken place. I may refer to the story of the madness and suicide of Lucretius, which is extremely doubtful, and may have grown out of a religious horror at the supposed tendency of his writings. The story of Newton's madness, again, which is given by a French biographer, and which is ably refuted by Sir David Brewster, may owe much of its piquancy to what may be called the unconscious inventiveness of prejudice. Very possibly the stories of the visions of Brutus, Cromwell, and others, have had a like origin.

Again, it will be said that even medical men—wishing like others to magnify their office—may have been too ready in spying out the symptoms of insanity. If they are fallible in dealing with the living subject, all of whose physical and mental characteristics are accessible to observation, how much more likely are they to err in diagnosing the minds of the dead by help of a few fragmentary indications only! I think the force of this objection, too, must be allowed. When, for example, a French alienist thinks it worth while to write a book in order to prove that the belief of Socrates in a controlling divinity (*τὸ δαιμόνιον*) was a symptom of mental disease, a layman may be pardoned for demanding a mode of investigation more in accordance with the proud claims of science to our absolute and unstinted confidence. A well-informed and critical reader of M. Moreau's tables of biographical facts will not fail to challenge more than one statement of his respecting the morbid characteristics of great men, ancient and modern.*

Allowing, however, for a margin of error, I do not think any candid mind will fail to see that such a body of facts as remains is sufficient to justify us in drawing a conclusion. If men of the highest intellectual caliber were not more liable to mental and nervous disorders than others, no such list out of the short roll of great names could have been obtained. No elaborate calculations are needed, I think, to show that mental malady occurs too often in the history of genius.†

One might perhaps try to evade the unpalatable conclusion by saying that there is genius and genius; that it is weakly, one-sided, and *bizarre* originality which exhibits these unhealthinesses, whereas the larger and more vigorous productiveness of an Aristotle, a Shakespeare, or a Goethe, is free from such blemishes.‡ I think, however,

* As when he sees in Swift's witty pamphlet on Ireland a distinct presage of oncoming insanity. In some cases he is inexact in stating his facts, as when he says that Saint-Simon committed suicide.

† The proportion is the more striking, because it is not known that insanity is particularly frequent among the more highly educated class of the community.

‡ This seems to be the idea of Dr. Oliver Wendell Holmes when he distinguishes between poets of "great sun-kindled constructive imagination" and those who have "a

that our facts will compel us to reject this saving clause. There is no question among competent critics of the splendid quality of genius of Swift, of Carlyle, or of Beethoven. Nor in cases of so-called healthy genius can it be said that nothing abnormal ever shows itself. The above references to Goethe may serve to indicate the liability to abnormal deviation even in the strongest and seemingly most stable type of genius. As for Shakespeare, the instance commonly referred to by Lamb and others who have come to the defense of genius, it is enough to say that our knowledge of his personality and life is far too meager to justify any conclusion on the point.*

And this brings us to another very important consideration. If too much has been made of the alleged positive instances, too much has been made also of the apparent contradictions or exceptions. The record of past greatness is far too scanty for the most plodding student to find all cases of morbid symptoms which have presented themselves. We who live in an age when a fierce light beats on the throne of intellect, when the public which genius serves is greedy of every trivial detail of information respecting its behavior in the curtained recess of private life, can hardly understand how our ancestors could have neglected to chronicle and to preserve the words and deeds of the greatest of men. Yet such is the case, and the further we go back the scantier the biographic page. Inasmuch, too, as many of the symptoms of nervous disease in the intellectual heroes themselves or their families would possess no significance to the ordinary lay mind, we may feel confident that in many cases where we have a fairly full record important data are omitted.

Another thought naturally occurs to one in this connection. Without indorsing the ancient proverb that the best men die in their youth, we may find good grounds for conjecturing that many endowed with the gift of genius have passed away before their powers culminated in the production of a great monumental work. The early collapse of so many who did attain fame suggests this conclusion. And among such short-lived and unknown recipients of the divine afflatus it seems reasonable to infer that there were a considerable number who succumbed to some of those forms of psycho-physical disease which have so often attacked their survivors.

It seems, then, to be an irresistible conclusion that the foremost among human intellects have had more than their share of the ills that flesh is heir to. The possession of genius appears in some way to be unfavorable to the maintenance of a robust mental health. And here arises the question how we are to view this connection. Is the

certain kind of moonlight genius given them to compensate them for their imperfection of nature," and who are invariably "tinged with melancholy" ("Autocrat of the Breakfast-Table," chap. viii).

* Even the little that we know does not all point one way. Against the fine business capacity, and so forth, we have to set the youthful excesses of which rumor speaks.

presence of the creative faculty to be regarded as itself an abnormal excrescence in the human mind? Or is it that the possession and fruition of the faculty are apt to be attended with circumstances which are injurious to perfect mental well-being?

In order to understand the precise relation between two things, we ought to know all about the nature and causes of each. But this we are very far from knowing in the present case. Science has, no doubt, done much to clear up the ancient mystery of madness. We now know that it has a perfectly natural origin, and we understand a good deal respecting the more conspicuous agencies, psychical and physical, predisposing and exciting, which bring about the malady. Yet so intricate is the subject, so complex and subtile the influences which may conspire to just disturb the mental balance, that in many cases, even with a full knowledge of an individual and his antecedents, the most skillful expert finds himself unable to give a complete and exhaustive explanation of the phenomenon.

With respect to genius the case is much worse. We may have a clearer intuition of its organic composition than the ancients; we may be able better than they to describe in psychological terms the essential qualities of the original and creative mind. But we have hardly advanced a step with respect to a knowledge of its genesis and antecedents. We do, no doubt, know some little about its family history. Mr. Galton, with his characteristic skill in striking out new paths of experimental research, has brought to light a number of interesting facts with respect to the hereditary transmission of high intellectual endowments. But these researches supply no answer to the supremely interesting question, How does the light of genius happen to flash out in this particular family at this precise moment? A preparation there may be, as Goethe somewhere hints, in the patient building up by the family of sterling intellectual and moral virtues. But this is hardly the beginning of an explanation. How much the better are we able to comprehend Carlyle's wondrous gift of spiritual clairvoyance for knowing that he came of a thoroughly sound stock, having more than the average, it may be, of Northern shrewdness? To trace the family characteristics in a great man is one thing, to explain the genius which ennobles and immortalizes these is another.*

In the present state of our knowledge, then, genius must be looked upon as the most signal and impressive manifestation of that tendency of Nature to variation and individuation in her organic formations which modern science is compelled to retain among its unexplained facts. Why we have a Shakespeare, a Michael Angelo, a Goethe here

* Much the same applies to what M. Taine and others have said about the larger preparation of the original teacher and the artist by the traditions of the community and the spirit of the age. See, for a careful treatment of the whole question of the antecedents of genius, an article by M. H. Joly, "Psychologie des Grands Hommes" (III) in the "Revue Philosophique," August, 1882.

and now, is a question that can not be answered. Our ignorance of the many hidden threads that make up the inextricable skein of causation forces us to regard each new appearance of the lamp of genius with much of the wonder, if with something less of the superstition, with which the ancients viewed it.

This being so, we must be content with a very tentative and provisional theory of the relations between genius and mental disease. We can not, for example, follow M. Moreau in his hardy paradox that genius has as its material substratum a semi-morbid state of the brain, a neuropathic constitution which is substantially identical with the "insane temperament" or "insane neurosis."* For, first of all, the facts do not support such a generalization. If the "genial temperament" involved a distinct constitutional disposition to insanity, the number of great men who had actually become insane would certainly be much greater than it is. And, in the second place, this proposition reposes on far too unsubstantial a basis of hypothetical neurology. We know too little of the variations of nerve structure and function to pronounce confidently on the essential identity of the nervous organization in the case of the man of genius and of the insane."†

A more modest and possibly more hopeful way of approaching the question appears to offer itself in the consideration of the psychical characteristics of genius. We may inquire into those peculiarities of sensibility and emotion, as well as of intellect, which are discoverable in the typical psychical organization of the great man, and may trace out some of the more important reflex influences of the life of intellectual production on his mind and character. What we all recognize as genius displays itself in some large original conception, whether artistic, scientific, or practical. And it seems not improbable that by a closer investigation of the conditions and the results of this large constructive activity of mind we may find a clew to the apparent anomaly that grand intellectual powers are so frequently beset with mental and moral infirmity. These lurking-places of abnormal tendencies will, we may expect, betray themselves more readily in the case of artistic and especially poetic genius, which has, indeed, always been viewed as the most pronounced form, and as the typical representative of creative power.

No careful student of genius can fail to see that it has its roots in a nervous organization of exceptional delicacy. Keenness of sensibility, both to physical and mental stimuli, is one of the fundamental attributes of the original mind. This preternatural sensitiveness of nerve has been illustrated in the two latest records of poetic genius. Car-

* *Op. cit.*, p. 463, *seq.*

† Dr. Maudsley is more guarded, contenting himself with saying, "It is truly remarkable how much mankind has been indebted for special displays of talent, if not of genius, to individuals who themselves, or whose parents, have sprung from families in which there has been some predisposition to insanity" ("Responsibility in Mental Disease," p. 47).

lyle's lively impressibility to sounds and other sensuous agents is familiar to all.* And of George Eliot it has been well said that "her nerves were servile to every skyey influence." And what a range and intensity of emotion are at once suggested by names like Milton, Dante, Shelley, Heine!

This fineness of the sentient fiber stands in the closest relation to the intellectual side of genius. It is not so much an accompaniment of the creative imagination as its vitalizing principle. The wide and penetrating vision of the poet is the correlative of his quick, delicate, and many-sided sensibility. And the stimulus which ever urges him toward the ideal region, which makes him devote his days to the pursuit of some ravishing idea, has its origin in his rare, almost superhuman, capacity of feeling. The modest limits of the real world fail to slake his thirst for the delight of beauty, for the raptures of the sublime. Hence the impulse to fashion new worlds of his own. And by such ideal activities the emotional sensibilities which prompted them are deepened and intensified.

It is easy to see, from this glance at the fundamental conditions of imaginative creation, that it has one of its main impulses in uncommon experiences of suffering. The fine nervous organization, tremulously responsive to every touch, constitutes in itself, in this all too imperfect world of ours, a special dispensation of sorrow. Exquisite sensibility seems to be connected with a delicate poise of nervous structure eminently favorable to the experience of jarring and dislocated shock. And it is this preponderance of rude shock over smooth, agreeable stimulation—of a sense of dissonance in things over the joyous consciousness of harmony—which seems to supply one of the most powerful incitants to the life of imagination. Hence the dark streak of melancholy which one so often detects in the early years of the great man.

Such an attitude of mind must entail suffering in other ways, As the biography of the man of genius often tells us, he is apt to become aware, at a painfully early date, that his exceptional endowments and the ardent consuming impulses which belong to them collide with the utilities and purposes of ordinary life. The soul intent on dreaming its secret dream of beauty is unfit for the business which makes up the common working life of plain, prosaic men. The youth to whom the embodiment of a noble artistic idea or the discovery of a large, fructifying, moral truth is the one absorbing interest, will be apt to take a shockingly low view of banking, schoolmastering, and the other respectable occupations of ordinary citizens.

It follows that the man of genius is, by his very constitution and vocation, to a considerable extent a solitary. He is apt to offend the world into which he was born by refusing to bow the knee to its conventional deities. His mood of discontent with things presents itself

* Goethe, Schopenhauer, and other great men, were particularly sensitive to sounds.

as a reflection on their contented view. On the other hand, his peculiar leanings and aspirations are incomprehensible to them, and stamp him as an alien. "Il y a peu de vices," says Chamfort, with a grim irony, "qui empêchent un homme d'avoir beaucoup d'amis, autant que peuvent le faire de trop grandes qualités." Hence the profound solitude of so many of the earth's great ones, which even the companionships of the home have not sufficed to fill up. And it must be remembered that the ardent emotions of the man of genius bring their extra need of sympathy. Even the consciousness of intellectual dissent from others may become to a deeply sympathetic nature an anguish. "I believe you know" (writes Leopardi to a friend), "but I hope you have not experienced, how thought can crucify and martyrize any one who thinks somewhat differently from others."

Such isolation is distinctly unfavorable to mental health. It deprives a man of wholesome contact with others' experience and ideas, and disposes to abnormal eccentricities of thought. It profoundly affects the emotional nature, breeding melancholy, suspicion of others, misanthropy, and other unwholesome progeny. The "strange interior *tomb* life" of which Carlyle speaks is a striking example of the influence of this isolation in fostering the minute germs of morbid delusion.

If now we turn to the process of intellectual origination, we shall find new elements of danger, new forces adverse to the perfect serenity of mental health. If the rich biographical literature of modern times teaches us anything, it is that original production is the severest strain of human faculty, the most violent and exhausting form of cerebral action. The pleasing fiction that the perfectly-shaped artistic product occurs to the creative mind as a kind of happy thought is at once dispelled by a little study of great men's recorded experience. All fine original work, it may be safely said, represents severe intellectual labor on the part of the producer, not necessarily at the moment of achievement, but at least in a preparatory collection and partial elaboration of material. The rapidity with which Scott threw off his masterpieces of fiction is only understood by remembering how he had steeped his imagination for years in the life, the scenery, and the history of his country.

It is to be remembered, too, that this swift and seemingly facile mode of creation is by no means an easy play of faculty, akin to the spontaneous sportiveness of witty talk. It involves the full tension of the mental powers, the driving of the cerebral machine at full speed. According to the testimony of more than one man of genius, this fierce activity is fed and sustained by violent emotional excitement.*

* Byron, Goethe, Dickens, and others attest to this. Compare what George Eliot says about the way in which the third volume of "Adam Bede" was produced ("Life," vol. ii, p. 155).

The notion of producing a work of high imaginative power in a state of perfect cold blood is, as Plato long ago pointed out, absurd. Spiritual generation only takes place when the soul burns and throbs as with a fever. At the moment of productive inspiration the whole being is agitated to its depths, and the latent deposits of years of experience come to the surface. This full spring-tide of imagination, this cerebral turmoil and clash of currents, makes the severest demands on the controlling and guiding forces of volition. And it is only when the mind is capable of the highest effort of sustained concentration that the process of selecting and organizing can keep pace with the rapid inflow of material. Hence, though the excitement may in certain cases be intensely pleasurable, it is nearly always fatiguing and wearing.

But great artistic works are not always flashed into the world by this swift electric process. Some books that men will not let die have been the result of lengthened toil troubled by many a miserable check and delay. The record of Carlyle's experience sufficiently illustrates the truth that there is no necessary relation between rapidity of invention and execution and artistic value of result.* Much depends on the passing mood, more still on the temperament of the individual artist. There are others besides Carlyle to whom spiritual parturition has been largely an experience of suffering, the pangs being but rarely submerged in the large, joyous consciousness that a new idea is born into the world. And when this is so there is another kind of strain on the mental machine. The struggle with intellectual obstacle, the fierce passionate resolve to come *in's Reine* which every student experiences in a humble way, becomes something for the spectator to tremble at.

Is it surprising that such states of mental stress and storm should afterward leave the subject exhausted and prostrate? The wild excitement of production is apt to dull the sense still further to the prosaic enjoyments with which ordinary mortals have to content themselves. More than this, the long and intense preoccupation with the things of the imagination is apt to induce a certain lethargy and stupor of the senses, in which the sharp outlines of reality are effaced in a misty, dream-like phantasmagoria. The reader of Carlyle's "Memoirs" need not be reminded how plainly all this appears in his experience. Even the warm and gladdening ray of dawning prosperity failed to cheer him in these hours of spiritual collapse. And he exclaims in one place that there is no other pleasure and possession for him but that of feeling himself working and alive.†

* M. Joly illustrates the same fact by the experience of Voltaire, "Revue Philosophique," November, 1882, pp. 496, 497.

† "Thomas Carlyle," vol. ii, p. 129. Probably one reason why painters so rarely show morbid mental traits is that in their case the function of the senses can never be so completely overborne by the weight of imagination.

In addition to these adverse forces, which have their origin in the common conditions of the life of genius, there are others which, though less constant, present themselves very frequently in co-operation with the first. It has often been remarked that the man of decided originality of thought, being as it were one born out of due time, has to bear the strain of production for a while uncheered by the smile of recognition. And when there is great originality, not only in the ideas, but in the form of expression, such recognition may come too slowly to be of any remunerative value. Neglect or ridicule is the form of greeting which the world has often given to the propounder of a new truth; and where, as frequently happens, the want of instant recognition means the pressure of poverty, which chafes with unusual severity the delicate fibers of sensitive men, we have a new and considerable force added to the agencies which threaten to undermine the not too stable edifice of the great man's mental and moral constitution. Johnson, Lessing, Burns, Leopardi, and many another name, will here occur to those familiar with the lives of modern men of letters.

In view of this combination of threatening agencies, one begins to understand the many eloquent things which have been said about the fatality of great gifts. Thus one finds a meaning in the definition of poetic genius given by Lamartine when speaking of Byron—"a vibration of the human fiber as strong as the heart of man can bear without breaking."

It is not meant here that even when all these destructive elements are present a distinctly pathological condition of mind must necessarily ensue. Their effect may be fully counteracted by other and resisting agencies. Of these the two most important are bodily energy and health on the one hand, and strength of will or character on the other. Where these are both found in a high degree of perfection, as in Goethe, we have a splendid example of healthy genius. On the other hand, if either, and still more if both of these are wanting, we have a state of things which is exceedingly likely to develop a distinctly pathological state of mind.*

How, it may be asked, does it commonly fare with the world's intellectual heroes with respect to these means of defense? As to the physical defense, it is known that a number of great men have had a physique fairly adequate to the severe demands made on the nervous organization. They were men of powerful frame, strong muscles, and good digestion. But such robustness of bodily health seems by no means the common rule. The number of puny and ill-formed men who have achieved marvelous things in intellectual production is a fact which has often been remarked on. So common an accompaniment of great intellectual exertion is defective digestion, that an in-

* That is, quite apart from any inherited physical predisposition to nervous disease.

genious writer has tried to show that the maladies of genius have their main source in dyspepsia.* No Englishman, in thinking of this question, can fail to recollect that the three of his countrywomen who have given most distinct proof of creative power—Charlotte Brontë, Mrs. Browning, and George Eliot—were hampered with a physical frame pitiably unequal to support the cerebral superstructure.†

Coming now to the moral defense, the thought at once suggests itself that, according to the testimony of more than one writer, genius consists in preternatural force of will more than in anything else. It is, we are told, only the man with an infinite capacity to take pains who is truly great. The prolonged, intense concentration of mind which precedes the final achievement is a severe exertion and striking manifestation of will.

At the same time, a moment's thought will show us that this patient mental incubation is no proof of the higher qualities of will and moral character.‡ The appropriateness of the old way of speaking of creative inspiration as a possession is seen in the fact that the will has little to do with bringing on the condition. "The author," said Lord Beaconsfield, on one occasion, "is a being with a predisposition which with him is irresistible, a bent which he can not in any way avoid, whether it drags him to the abstruse researches of erudition, or induces him to mount into the feverish and turbulent atmosphere of imagination." This sense of a *quasi*-exterior pressure and compulsion is attested by more than one child of genius. In some cases, more particularly, perhaps, among "tone-poets," we find this mastery of the individual mind by the creative impulse assuming the striking form of a sudden abstraction of the thoughts from the surroundings of the moment. And, throughout the whole of the creative process, the will, though, as we have seen, exercised in a peculiarly severe effort, is not exercised fully and in its highest form. There is no deliberate choice of activity here. The man does not feel free to stop or to go on. On the contrary, the will is in this case pressed into the service of the particular emotion that strives for utterance, the particular artistic impulse that is irresistibly bent on self-realization. There is nothing here of the higher moral effort of will, in choosing what we are not at the

* R. R. Madden, "On the Infirmities of Genius."

† Schopenhauer, in the passages of his work already referred to, discusses in a curious and characteristic way the physical basis of genius. Moreau quotes approvingly the remark of Lecanus, that men of the finest genius were "of a feeble constitution and often infirm." On the other hand, Mr. Galton, in his "Hereditary Genius," contends that the heroes of history are at least up to the average of men in physical strength. It is to be remarked, however, that the reference to university statistics is apt to mislead here. Senior wranglers can hardly be taken as representative of creative power.

‡ It is evident that only speculative, as distinguished from practical genius, is here referred to. The man of great constructive powers in affairs—the statesman, general, and so forth—requires will in the higher and fuller sense. And it has been remarked that these organizing intellects rarely exhibit pathological symptoms.

moment inclined to, and resisting the seductive force of extraneous excitants.*

These fragmentary remarks may help us to understand the facts of the case. A certain proportion of great thinkers and artists have shown moral as well as intellectual heroism. Men who were able to take the destruction of a MS. representing long and wearisome research, as Newton and Carlyle took it, must have had something of the stuff of which the stoutest character is woven. The patient upbearing against hardship of men like Johnson and Lessing is what gives the moral relish to the biography of men of letters. More than one intellectual leader, too, has shown the rare quality of practical wisdom. Goethe's calm strength of will, displaying itself in a careful ordering of the daily life, is matter of common knowledge. Beethoven managed just to keep himself right by resolute bodily exercise. In George Eliot an exceptional feeling of moral responsibility sufficed for a nice economizing of the fitful supply of physical energy.

At the same time, our slight study of the ways of genius has familiarized us with illustrations of striking moral weaknesses. We have seen a meaning in Rochefoucauld's paradox, that "il n'appartient qu'aux grands hommes d'avoir de grands défauts." The large draught of mental energy into the channels of imaginative production is apt to leave the will ill-provided in working out the multifarious tasks of a temperate and virtuous life.

Our conclusion is, that the possession of genius carries with it special liabilities to the action of the disintegrating forces which environ us all. It involves a state of delicate equipoise, of unstable equilibrium, in the psycho-physical organization. Paradoxical as it may seem, one may venture to affirm that great original power of mind is incompatible with nice adjustment to surroundings, and so with perfect well-being. And here it is that we see the real qualitative difference between genius and talent. This last means superior endowment in respect of the common practical intelligence which all men understand and appraise. The man of talent follows the current modes of thought, keeps his eye steadily fixed on the popular eye, produces the kind of thing which hits the taste of the moment, and is never guilty of the folly of abandoning himself to the intoxicating excitement of production. To the original inventor of ideas and molder of new forms of art this intoxication is, as we have seen, everything. He is under a kind of divine behest to make and fashion something new and great, and at the moment of compliance recks little of the practical outcome to himself. And such recklessness is clearly only one form of imprudence, and so of mal-adaptation.

* This fact of the absence of choice, and the ordinary co-operation of the personal will in artistic production, is illustrated further in the rapidity with which the mind casts off and ignores its offspring. "Est-ce bien moi qui ai fait cela?" asked Voltaire once, on seeing one of his dramas acted. George Eliot attests to this strange unmaternal feeling toward her literary children.

But, if improvident, he is improvident in a high cause. Emerson and others have taught us the uses of the great man. The teacher of a new truth, the discoverer of a higher and worthier form of artistic expression, is one in advance of his age, who, by his giant exertions, enables the community, and even the whole race, to reach forward to a further point in the line of intellectual evolution. He is a scout who rides out well in advance of the intellectual army, and who by this very advance and isolation from the main body is exposed to special perils. Thus genius, like philanthropy or conscious self-sacrifice for others, is a mode of variation of human nature which, though unfavorable to the conservation of the individual, aids in the evolution of the species.

If this be a sound view of the nature and social function of the man of genius, it may teach more than one practical lesson. Does it not, for example, suggest that there is room just now for more consideration in dealing with the infirmities of great men? There is no need of exonerating intellectual giants from the graver human responsibilities. We do well to remember that genius has its own special responsibilities, that *noblesse oblige* here too. At the same time we shall do well also to keep in mind that the life of intellectual creation has its own peculiar besetments, and that in the very task of fulfilling his high and eminently humane mission, and giving the world of his mind's best, the great man may become unequal to the smaller fortitudes of every-day life. To judge of the degree of blameworthiness of faults of temper is a nice operation, which may even transcend the ability of a clever and practiced critic. Perhaps the temper most appropriate to the contemplation of genius, and most conducive to fairness of moral judgment, is one in which reverence is softened by personal gratitude, and this last made more completely human by a touch of regretful pity.—*Nineteenth Century.*

AN EXPERIMENT IN PRIMARY EDUCATION.

By Dr. MARY PUTNAM-JACOBI.

I.

IN modern times education has been recognized to be something more than an elegant luxury, designed exclusively for the benefit of the "upper classes." It is a force, and a potent and indisputable means, not only for the training but for the evocation of forces. It is able, not only to convey information, but to increase power. It is not simply a social convention, but a real means for attaining real ends. The final ends of education are efficiency and repose. The educated person is he who knows how to get what he wants, and how to enjoy it when he has got it.

When a "higher education" is demanded, for any class of persons —as women—it means that it has become desirable to train their faculties for more difficult work than that traditionally assigned to them, and also that it is desirable to enable them to get more enjoyment out of any work that they do. The necessary correlative of the possession of powers is the opportunity for their exercise. The existence of a larger class of effectively educated women must increase their demand for a larger share in that part of the world's work which requires trained intelligence. Of this, literature and other art is one and only one portion. The work of the professions, of the upper regions of industry, commerce, and finance, the work of scientific and of political life, is the work appropriate to the intelligences which have proved themselves equal to a course of training at once complex and severe. A person destined to receive a superior education is expected to develop more vigorous mental force, to have a larger mental horizon, to handle more complex masses of ideas, than another. From the beginning, therefore, he must not merely receive useful information, but be habituated to perform difficult mental operations, for only in this way can the sum of mental power be increased. The order, arrangement, and sequence of the ideas he acquires must be as carefully planned as is the selection of the ideas themselves, because upon this order and internal proportion his mental horizon depends. He must be trained in feats of sustained attention, and in the collocation and association of elementary ideas into complex combinations. Since ideas are abstractions from sense-perceptions, he must be exercised in the acquisition of accurate, rapid, far-reaching, and delicate sense perceptions, in their memorization, and in the representative imagination which may recall them at will, and be able to abstract from them, more or less remotely, ideas. Habits of rich association of ideas must be formed, and of pleasure in their contemplation. And very early must be offered to the child problems to be solved, either by purely mental exertion, or by that combined with manual labor. And all this care must be taken for girls as well as for boys, so soon as it is seriously agreed that girls may be admitted to a superior as well as to a primary education.

The first intellectual faculties to be trained are perception and memory. The subjects of the child's first studies should therefore be selected, not on account of their ultimate utility, but on account of their influence upon the development of these faculties. What sense is there, then, in beginning education with instruction in the arts of reading and writing? If literature were the main business of life, or if, as was at one time supposed, education meant nothing else but acquaintance with literature, there would be some logic in the extraordinary prominence habitually assigned in education to the study of modes of literary expression. But, from the modern stand-point, that education means such an unfolding of the faculties as shall put the

mind into the widest and most effective relation with the entire world of things—spiritual and material—there is an exquisite absurdity in the time-honored method. To study words before things tends to impress the mind with a fatal belief in their superior importance. To study expression before subjects of thought have been accumulated, is to cultivate the habit, always prevalent in civilized life, of talking fluently without having anything to say. To direct attention to sets of arbitrary signs before attention has been trained by contemplation of real objects, teaches the mind to place conventional and contingent facts on the same level with necessary truths. We thus weaken in advance the power of belief in necessity and reality. Without such power the mind becomes inevitably the prey to a skepticism generated much less by contradictions in the outside world, than by the weakness of its internal organism. What other result should logically be produced, when, to the opening mind, as it turns eagerly to the wonderful world in which it awakens and finds itself, we offer for contemplation, exercise, and earliest sustenance, the alphabet, the abstruse structure of words to be spelled, the grammar of sentences to be construed, the complex gymnastics of copies to be written? When to the reading, writing, spelling, grammar, and composition in English, we add that of similar exercises in two or three other languages, we evidently describe the education, first, of the children in our public schools, then of those of the so-called "upper classes"; and show that all is a prolonged study of words.

Words are fossils, which, according to the understanding had of them, are a heap of meaningless stones, or the incarnation of a bygone life. When the child has once learned to handle present existences, he will be prepared to understand the reflections of a past life in language. When he has had some experience in framing complex abstractions, he can then appreciate the complex abstractions of speech. But, until then, language should not be to him an object of thought, but only an organ of thought. It is not to be driven *into* him, but only *out* of him, through the urgent consciousness that something must be said. The inflections, intonations, and emphasis of speech, uttered or written—and which include grammar, rhetoric, punctuation, style—must arise spontaneously, as natural clothing of the idea, which insists upon making itself understood. An idea which is once sufficiently vivid in the child's mind can hardly fail to "climb to a form in the grass and flowers" of picturesque baby-speech.

On this principle it might be useful to precede study of either spoken or written language by study of gestures and signs. At all events, in my own experiment, the child was taught algebraic signs as a means of concisely expressing certain relations, long before any attempt was made to learn how to write. Thus the important, fundamental idea was early conveyed to her mind that all arts of expression were subordinate in importance to the subject expressed. Deliberate

study of the arts of expression, which is equivalent to the study of literature, rhetoric, and style, was reserved until after many years of study of things should have accumulated impressions and ideas which spontaneously sought an outlet. Further, the child was taught to draw in simple combinations of lines for many months before attempting to write. When this difficult and complex muscular exercise was approached, she began it with unusual ease, and in a few weeks, at the age of six, already commanded a firm and legible handwriting. Further, and for the same purpose, no set copy-book was used from which meaningless sentences could be imitated; but the child proceeded at once to utilize the art of writing in precisely the same way that humanity has done in passing from barbarism with spoken traditions, to civilization with a recorded history. She recorded at first with printed, afterward with script characters, the history of a group of hyacinths, whose development she watched from birth to death. The writing, though compelled to be carefully done, was recognized as no end in itself, but as a means to preserve a connected history of a series of interesting events, otherwise liable to lapse into oblivion. The art was thus approached as all arts should be, from the stand-point of its real genesis, and tended to place itself in the same relative position in the child's mind that it had occupied in the real history of the world.

Study of the pathological conditions of writer's cramp, and of the numerous brain-lesions which have so marvelously dissected the faculty of comprehending verbal and written signs, has revealed a hitherto unsuspected complexity in the muscular movements involved in writing, and of the mental processes necessary to language.* The discovery has not yet modified the glaring crudity of the educational methods which persist in beginning mental training with a forced drill in these complex processes and gymnastics.

Not speech abstractions, the highest conquest of the mind, but the development of the visual conceptions, which are its earliest spontaneous achievement, should be the first object of systematic training. Forms and colors are the elements of all visual impressions; and these are, moreover, susceptible of a scientific classification which can, from the beginning, be rendered appreciable to the child. It is upon forms and colors, therefore, that both perception and memory must first be exercised. The visual impression should be amplified up to the point at which it is able to fix itself on the mind by its own momentum; therefore, without conscious effort. When the mind has accumulated a stock of reminiscences which *can not* be forgotten, it will, by so much, have enriched its structure and enlarged its furniture. It is then prepared for voluntary efforts at recollection.

The amplification of the impression is effected in two ways: 1. The impression may be associated with an action on the part of the child,

* See Kussmaul, "Stoerungen der Sprache"; also, Lichtheim on "Aphasia" ("Brain," January, 1885). The literature on these two subjects is already immense.

as when he arranges building-blocks into definite forms. 2. The outlines of the object itself may be magnified, and at the same time roughened, by being copied with sticks, as may be done in the first attempts at map-drawing. The copy substitutes a schematic outline for the real one, but by the very fact blends a mental conception with the simple visual image. This necessity for amplification is very important, and, as it seems to me, very often overlooked. It is strictly in accordance with the physiological law in neuro-dynamics, that a stimulating impression must vary in intensity inversely to the susceptibility of the nerve-element to be impressed. The more developed and vigorous the mind, the slighter the object that is perceived and remembered; and, as Mr. Froude remarks, men of genius always have tenacious memories. Conversely, the relatively feeble mind of the young child requires a large object to awaken its prehensile faculties. If the memory of children for what has once impressed them is often remarkable, it is because the infantile period of mental development bears much analogy with the character of genius.

It seems to me that for several years no abstract statements should be made to a child, except such as may be, at least schematically, represented by tangible objects, and at every new point of even advanced studies recurrence to such schemas may be usefully made.

Perception and memory should be indissolubly associated. There are two prevalent errors of method which I have noticed: to expect a child to remember what it has never perceived; and to allow it to perceive without any systematic representation of the object in memory. In the earliest training, contemplation of an object is insufficient to fix its outlines on the mind: it must be handled as well as seen. In my own experiment with a child of four, Froebel's building-blocks were used to construct definite models; but these, once framed, were repeated from memory. Sometimes the details of an exciting story, as that of "Blue-Beard," were associated with the different details of the model, so that these were more vividly remembered.

By building in succession the different rooms in which the various acts of the tragedy were supposed to have occurred, the child learned, on the one hand, mathematical outlines; on the other hand, to remember history by, in a degree, acting history herself. The principle of this method is applicable to much more advanced studies.

President Hill, in his eloquent little book on the "True Order of Studies," emphatically insists on the necessity for a selection of studies which differ widely from the conventional programme. "We awake to consciousness," he observes, "through the fact of motion which reveals to us an outer world, and a universe of space and time in which that world of matter moves. These space and time relations are the earliest objects of distinctly conscious intellection; the first objects concerning which our knowledge takes a scientific form. This was true of the race, and it is true of the individual. Before the child has

a clearly intellectual life on any other subjects, it attains a very definite power to distinguish the square, the circle, the oval, the spiral; and also to recognize the rhythm of verse and music. Out of space and time arise through the suggestions of the material world three principal sciences: geometry, arithmetic, algebra. In considering space we are led to imitate the act of the Divine Intellect, which has geometrized from eternity. Geometry is the earliest and simplest of all possible sciences." The writer proceeds to point out that "the earliest abstraction from the idea of form is that of number, and out of this idea is evolved the earliest of the truly abstract sciences, namely, arithmetic. But because this science is based upon an abstraction, and not upon a direct perception, it should be made to follow, and not, as is usually the case, precede geometry." Again, "the earliest suggestions of motion reveal to us time as well as space. But space is external to the mind; time enters into our spiritual consciousness, and measures our flow of thought."

To this might be added the anatomical consideration that the formation of space conceptions is the function of the cerebrum, from the impressions furnished by the optic nerve; while the conceptions of time are elaborated in the cerebellum from the experience in successions of events furnished by the auditory nerve. Space conceptions are objective, static; time conceptions, from the beginning subjective, are at first successive, then become progressive, finally causal, dynamic—when the conception of cause arises from consideration of the sum of antecedent events. Thus this second series of conceptions soon impinges upon moral considerations; the first remains within the sphere of perceptive intelligence. To space, or optic nerve conceptions, belongs symmetry; to time, or auditory nerve conceptions, belong harmony and rhythm.

These ultimate ramifications of the primary psychic phenomenon must be held in mind at the moment of beginning to systematize the visual and auditory perceptions which lie at their basis.

All object-teaching may be made useful as a means of training to independent observation. But the study of ordinary, i. e., of complex objects, is necessarily empirical, whereas geometric forms can be at once submitted to scientific generalizations, can therefore at once initiate the child into scientific method. Dr. Hill recommends the study of geometry to be begun at the age of eight. The child upon which my own experiment was performed began the study of geometric elements before she was four. Some details of her education may perhaps be quoted as the best way of illustrating certain abstract principles. At the age of four and a half she had learned the following elements: straight, curved, slanting, and half-slanting lines, also to distinguish perpendicular and horizontal lines, and to draw either straight or curved lines parallel to each other. She was well acquainted with all forms of the triangle, equilateral, isosceles, right angle, and

scalene. She knew a rectangle and a square, and the relations to each of the slanting and half-slanting line. She knew also, and was especially fond of, the trapezium, trapezoid, the pentagon, hexagon, etc., the circle and semicircle; and, in solid figures, knew the cube and its apparent relations to the square. She did not merely know the names of these things, but to her eye the whole perceptible universe arranged itself spontaneously into these fundamental forms; for she was incessantly disentangling them from the complex appearances of surrounding objects. Thus a horse-railroad interested her as an illustration of parallel straight lines which never met, the marks of carriage-wheels as parallel curved lines, the marks of horseshoes, as "dear little curves." She learned that the curved line was the line of living things, and that straight lines belonged exclusively to artificial objects. At dinner she divided her cake into squares or cubes, and made pentagons and octagons with the knives and forks. She learned that by increasing the number of sides a plane figure gradually progressed from a triangle to a circle; and thus, on first seeing a cylinder, at once compared it to a circle, because "it had ever and ever so many sides," and not to a prism with which the superficial resemblance might be supposed to be more striking.

The habit of looking for the forms of things led the child to the spontaneous observation of the alphabet, which she taught herself by incessantly copying the letters until she was familiar with them.* It was at this time that her education devolved upon me, and I began to effect the transition from a simple descriptive study of geometric forms toward some conception of their necessary relations. At first the purely descriptive study of geometric forms was continued, and, for several months and by the help of wooden models, extended from plane to solid figures. Later, when she was five and a half, some necessary relations were taught. Thus the child learned that three was the smallest number of straight lines which could include a space, by building with colored sticks an imaginary fence around a field in which a goat was to be inclosed. It was obvious that, when only two sides of the fence were completed, the goat would be able to run out and wreak all the destruction in the garden which might be anticipated from a reckless and unrestrained goat. An indissoluble association of ideas was thus established between a geometric necessity and the logic of events.

The second axiom taught was the equality of any two objects which were demonstrably equal to the same third. This was learned when the child was five years old; and illustrated in the first place by its applicability to the solution of problems otherwise insoluble. Thus, if it became necessary to compare the height of two girls, one of whom lived in Syracuse and the other in Boston, but unable to visit

* This first year of the child's education was carried on in the Kindergarten of Mrs. Walton.

each other, a common measure was suggested in the person of a third girl living in New York, of more peripatetic habits, and able to travel from one place to another. By the same device the lesser difficulty was overcome, of comparing the length of a floor and the ceiling of a room through the medium of the wall. Ultimately the problem was illustrated by the less conspicuous mechanisms of colored sticks, and then the first algebraic signs of equality and inequality were taught, thus preceding all knowledge of writing. When the idea had been thus copiously illustrated and perfectly grasped, the verbal axiom ("things equal to the same things," etc.) was, by exception, given, and learned with ease. This was proved by the child's remark on one occasion of applying the axiom, "I knew what I was *thereforeing*." In a similar way were taught some other axioms—thus, that equals being added to equals the wholes are equal, and that the whole is equal to the sum of its parts. The last axiom was illustrated graphically by observation of a large complex fungus which the child happened to pick up during a walk. Each part was apparently independent, yet so inseparable from the whole in which it inhered, and the whole was so obviously composed of these aggregated segments, that the axiom in question seemed to the child simply descriptive of the object.

Thus the mind was early initiated into the recognition of necessary truths, however few, lest otherwise it should never acquire that sense of reality and necessity which is essential to all forcible mental and moral action.

At the beginning of the year, the child being four and a half, the study of elementary colors was added to that of form. It was begun logically with observation of the rainbow. The child was led to notice and distinguish its colors in their regular order, and subsequently to reproduce this order exactly by means of colored sticks. As this was a fundamental observation among those furnished by the universe of things, it was constantly allowed to recur in different combinations in the same way as the original theme of a musical symphony. Thus at first the colored sticks were laid parallel to each other in a simple package. Subsequently the study of form and color was combined by using the same colored sticks to construct angular geometric figures from the triangle to the decagon. Each figure consisted of seven of different sizes and colors, placed concentrically to each other, in the rainbow order. After several months a third complication was introduced, by imagining that each color represented a lineal bed of flowers, the flowers having been previously gathered by the child and their colors compared. At this time solid figures would be placed in the center of the innermost plane figure outlined by the sticks, thus bringing out clearly the relations of the sides of such solids to certain planes. Thus a cube would stand in a square, a tetrahedron or pyramid in the center of a triangle. This last case offered the occasion

for a somewhat wide reach of fancy: for pictures were shown exhibiting pyramids in the Egyptian Desert, to imitate which the table was strewed with sand. Then the different triangles were outlined with sticks, representing successive beds of flowers breaking the desolation of the desert—thus, roses and pinks, then marigolds, then yellow snap-dragons, jonquils, and laburnums, then a bed of green leaves, another of periwinkles and blue bells, a sixth of hyacinths and a seventh of violets. Thus the entire exercise embraced conceptions of form, and of the relations of plane to solid geometric figures, conceptions of color, discovery of the origin of these in a grand cosmic phenomenon, utilization of colors as one means of classification in a new science, that of botany, impressions of beauty from the actual color combinations, and from reference, partly actual, partly from memory, to the lovely flowers suggested; finally, a large imagination of a distant land more or less distinctly suggested by the picture. The exercise was thus both orderly and complex; it required a prolonged effort of sustained attention, and implied the association of quite a number of different ideas into a single massive conception. Finally, none of these ideas were represented by a verbal formula, but each as the scarcely removed abstraction from a tangible object, that the child could freely handle. The exercise was thus a typical illustration of the methods which I have defined as suited to develop a higher order of intellectual capacity.

The second step in the study of cosmic phenomena, which had been begun by observation of the rainbow, consisted in study of the points of the compass. The child was first taught to construct, from Kindergarten tablets, figures which might serve to indicate the points of the compass; afterward she was obliged to recognize these points out-of-doors by reference to the rising and setting sun. Every morning she ascertained the direction of the winds and waves. She was then taught the points on a real compass, and how to direct her country walks by means of this instrument. This was her first initiation into the use of instruments of precision. It was gradually extended during the year by means of practical experiments with the mathematical compass, ruler, spirit-level, pulley, wedge, and balance. The use of the last instrument, together with that of measures, greatly simplified and abridged the labor ordinarily devoted in arithmetic to learning about weights and measures. The child was taught the metric system first, because it was logical, because it assimilated readily with American decimal currency, and because the mutual interconversion of weight and capacity practically demonstrated—e. g., by showing that a cubic centimetre of water weighed a gramme—prepared the way for the great idea, to come later, of scientific correlations. The English weights and measures were learned afterward, as historical accidents, not logical, but of some practical convenience, as purely contingent knowledge to be learned practically as the occasion presented

itself. She was sent to the grocer's to buy a bushel of apples, compared quarts, pecks, etc., together, and was never troubled with the senseless memorization of tables.

After knowledge of the rainbow and the points of the compass, the third cosmic notion acquired was that of perspective. This was first learned by watching ships passing over the water near which the child was playing, and observing their diminution of size as the distance increased. This observation made a profound impression upon the child; it was, perhaps, the first time that she learned that appearances do not always correspond to the reality of things, and that simple perceptions must be constantly controlled by an effort of the reasoning intellect. A year later, thus, when the child was five years old, the subject of perspective was reviewed in a different connection. She tried to draw a cube, and was shown the device by which a slanting line is made to represent a retreat from the foreground to a distance. This new discovery proved as exciting as the first had been, and it was speedily tested on all the pictures hanging in the room. On the first occasion, perspective had appeared like a great and astonishing fact of the external universe; on the second, like an immense achievement of the human intellect, which had thus contrived to accomplish the apparently impossible—namely, the representation of solid objects on a flat surface. The lifting of such large horizons makes epochs in the history of the intellect! The study was not confined to the form or line, but extended to observation of the effect of light and shade—the darkness of a receding surface, the brightness of the nearest point of a spherical surface, etc. Then the child reproduced these effects in her own drawing.

At this time the child began the study of geographical maps, as another method of emphasizing space conceptions. For so young a child the dissecting map was much simpler than would have been the attempt to make actual surveys of familiar localities, as is sometimes recommended. These were deferred till a little later. By the aid of the dissecting map, the child learned the outline of each of the United States, and their exact relations to each other, while still quite unable to read the names printed upon the models. In putting the map together, the compass was again brought into requisition, and the table on which the map was constructed turned until it faced the real north. The relative situation of places was always learned by reference to the compass, and not by arbitrary signs.

With so young a child it was impossible to associate much real information with these unknown states whose geometrical outlines she studied; therefore, every facility was offered to establish associations of fantasy, either with the shape of the pieces or with the names, association which the child usually discovered for herself. Thus, she described Virginia as a kneeling camel; Texas, for some reason which I could not appreciate, as a man leaning on his pipe; Maine, as a dog's head; Tennessee, as a boy's sled, etc.

The study of the one dissecting map was pursued uninterruptedly for six months. In a few weeks the child had learned to identify and name each piece, either on her model or on other maps, and could put each in its place. Before she left the map she was able to bound any State with the models, or verbally; also to make strips of successive States, beginning at any point and running in any direction. With the entrance upon her second year, at the age of five and a half, the child began the study of maps from "Cornell's Geography." But in a very little while these were exchanged for a large relief-globe. From the time the child began the study of this globe it became difficult for me to understand how any other method could ever be employed. The picturesque effect of the distinctly outlined continents, visible at a considerable distance, separated by vast tracts of desolate ocean, in which, as the child remarked, "one could easily drown," the mutual relations of parts whose perception need never be disturbed, as is incessantly done when the pupil passes from map to map—all these effects and impressions can be obtained from nothing else but from a globe of adequate size and in relief. The child, when just six, began to draw maps from this globe. On a single very large piece of paper would be represented whatever outlines were discoverable at the maximum distance and at a certain aspect of the globe. The latter was then revolved somewhat, the child remaining at the same distance, and a new map outlined as before, and so on until the entire globe had been, in the major outlines, copied by the child. It was reserved for months of future study to fill in the details in proportion to their successive natural, not political, importance.

Four different spheres of thought were prepared for by this study. First, and most obviously, the foundations were laid for all knowledge of physical geography. This foundation was laid in vivid sense impressions, and unalloyed with the singular mess of political, historical, and commercial details, with which even the best geographical textbooks for children are filled, and which are quite irrelevant to the main issue. When the child could with her finger trace the watercourses all around the world, she received a large fundamental impression not easily forgotten. Incidentally in this tracing she learned the value of canals at the Isthmuses of Suez and Panama. Secondly, a solid foundation was laid for history. The first map drawn was of Africa, on account of its simplicity of outline; but this involved the basin of the Mediterranean. The second map, passing eastward, took in the strongly accentuated outlines surrounding the Indian Ocean, and indicated the Himalaya and the high table-lands of Northern India. In the future it was intended, with these same outlines under the eye, and the picture of them deeply graven on the brain, to indicate the descent of Aryan ancestors from these table-lands toward the Mediterranean basin—the germinal spot of our historical world; thence the further spread westward to the new hemisphere. The conception of an histori-

cal germinal spot was again prepared for in advance, by showing the child the cicatricule of a hen's egg, lying like the Mediterranean basin, on a globe. Thirdly, study of the systematized topography of the globe constituted the best initiation into the study of all topographical relations, including those involved in animal anatomy, and therefore this consideration was not among the least important. Fourthly, an important elementary philosophical training was obtained, as the child learned to analyze into their details the largest pictures offered by the globe, and to arrange these details into orders of successive degrees of generalization. Great care was taken that all pictures or outlines of the same magnitude, and hence visible at the same distance, should be studied at the same time, and not associated with less conspicuous details that required more minute attention. This rule of following successive degrees of generalization in geographical analysis is most imperfectly observed in text-books. It imposes itself in study of the relief-globe.

[*To be continued.*]

ON LEAVES.

By Sir JOHN LUBBOCK.

II.

WE have hitherto been considering, for the most part, deciduous trees. It is generally supposed that in autumn the leaves drop off because they die. My impression is that most persons would be very much surprised to hear that this is not altogether the case. In fact, however, the separation is a vital process, and, if a bough is killed, the leaves are not thrown off, but remain attached to it. Indeed, the dead leaves not only remain *in situ*, but they are still firmly attached. Being dead and withered, they give the impression that the least shock would detach them; on the contrary, however, they will often bear a weight of as much as two pounds without coming off.

In evergreen species the conditions are in many respects different. When we have an early fall of snow in autumn, the trees which still retain their leaves are often very much broken down. Hence, perhaps, the comparative paucity of evergreens in temperate regions, and the tendency of evergreens to have smooth and glossy leaves, such as those of the holly, box, and evergreen-oak. Hairy leaves especially retain the snow, on which more and more accumulates.

Again, evergreen leaves sometimes remain on the tree for several years; for instance, in the Scotch pine three or four years, the spruce and silver-fir six or even seven, the yew eight, *A. pinsapo* sixteen or seventeen, araucaria and others even longer. It is true that during

the later years they gradually dry and wither; still, under these circumstances they naturally require special protection. They are, as a general rule, tough, and even leathery. In many species, again, as is the case with our holly, they are spinose. This serves as a protection from browsing animals; and in this way we can, I think, explain the curious fact that, while young hollies have spiny leaves, those of older trees, which are out of the reach of browsing animals, tend to become quite unarmed.

In confirmation of this I may also adduce the fact that while in the evergreen-oak the leaves on well-grown trees are entire and smooth-edged like those of the laurel, specimens which are cropped and kept low form scrubby brushes with hard prickly leaves.*

Mr. Grindon, in his "Echoes on Plant and Flower Life" (p. 30), says that "the occurrence of prickles only here and there among plants shows them to be unconnected with any general and ruling requirement of vegetation. We can only fall back upon the principle laid down at the outset, that they are illustrations of the unity of design in Nature, leading us away from the earth to Him who is 'the end of problems and the font of certainties.'" Surely, however, it is obvious that the existence of spines and prickles serves as a protection.

Another point of much importance in the economy of leaves is the presence or absence of hairs. I have already observed that most evergreens are glossy and smooth, and have suggested that this may be an advantage, as tending to prevent the adherence of snow, which might otherwise accumulate and break them down.

The hairs which occur on so many leaves are of several different types. Thus, leaves are called silky when clothed with long, even, shining hairs (silver-weed); pubescent or downy, when they are clothed with soft, short hairs (strawberry); pilose, when the hairs are long and scattered (herb-robert); villous, when the hairs are rather long, soft, white, and close (forget-me-not); hirsute, when the hairs are long and numerous (rose-campion); hispid, when they are erect and stiff (borage); setose, when they are long, spreading, and bristly (poppy); tomentose, when they are rather short, soft, and matted; woolly, when long, appressed, curly, but not matted (corn-centaury); velvety, when the pubescence is short and soft to the touch (foxglove); cobwebby, when the hairs are long, very fine, and interlaced like a cobweb (thistle, cobwebby houseleek). The arrangement of the hairs is also interesting. In some plants there is a double row of hairs along the stem. In the chickweed only one. This, perhaps, serves to collect rain and dew, and it is significant that the row of hairs is always opposite to the flower-stalk, which also has a single row. Now, the flower-stalk is for a considerable part of its life turned downward, with the row of hair outward. This, perhaps, may account for the absence of hairs on that side of the stem.

* Bunbury, "Botanical Fragments," p. 320.

Many leaves are clothed with woolly hairs while in the bud, which afterward disappear. Thus, in the rhododendron, horse-chestnut, and other species, the young leaves are protected by a thick felt, which, when they expand, becomes detached and drops off. Many leaves are smooth on the upper side, while underneath they are clothed with a cottony, often whitish, felt. This probably serves as a protection for the stomata. In some cases the hairs probably tend to preserve the leaves from being eaten. In others, as Kerner has suggested, they serve to keep off insects—apparently with the special object of preventing the flowers from being robbed of their honey by insects which are not adapted to fertilize them. Fritz Müller, to whom we are indebted for so many ingenious observations, gives an interesting case. The caterpillar of *Œnomia eagrus*, when about to turn into the chrysalis (Fig. 20), breaks off its hairs and fastens them to the twig which it has selected, so as to form on each side of itself about half a dozen stiff fences, to protect it during its helpless period of quiescence.

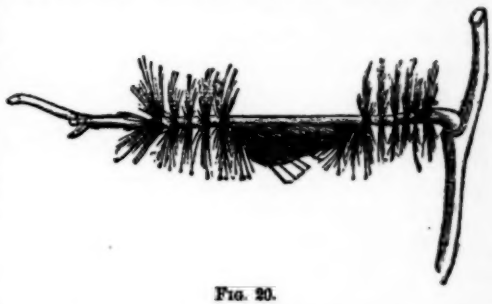


FIG. 20.

Vaucher long ago observed, though he gave no reason for the fact, that among the *Malvaceæ* (mallows) the species which produce honey are hairy, and those which do not are glabrous.

If we make a list of our English plants, marking out which species have honey and which have hairs, we shall find that we may lay it down as a general rule that honey and hairs go together. The exceptions, indeed, are very numerous, but when we come to examine them we shall find that they can generally be accounted for. I have made a rough list of the species in the English flora which have honey and yet are glabrous. It does not profess to be exactly correct, because there are some species with reference to which I was unable to ascertain by personal examination, or by reference to books, whether they produced honey or not. My list, however, comprised 110 species.

Now, in the first place, of these 110 species, in sixty the entrance to the honey is so narrow that even an ant could not force its way in; twenty are aquatic, and hence more or less protected from the visits of ants and other creeping insects; thus we shall frequently find that, if, in a generally hairy genus, one or more species are aquatic, they are also glabrous—as, for instance, *Viola palustris*, *Veronica anagallis*, *V. beccabunga*, and *Ranunculus aquatilis*. *Polygonum amphibium* is peculiarly interesting, because, as Kerner has pointed out, aquatic specimens are glabrous; while in those living on land the base of the leaf

produces hairs. Half a dozen are early spring plants which flower before the ants are roused from their winter sleep; about the same number are minute ground-plants to which hairs could be no protection; three or four are night flowers; there still remain a few to be accounted for, which would have to be considered individually, but probably the evidence is sufficiently complete to justify the general inference.

Lastly, I must not omit to mention the hairs which have a glandular character.

The next point to which I would call attention is the remarkable manner in which certain forms repeat themselves. In some cases, there seems much reason to suppose that one plant derives a substantial advantage from resembling another. For instance, *Chrysanthemum inodorum*, the scentless mayweed, very closely resembles the camomile in leaves, flowers, and general habit. The latter species, however, has a strong, bitter taste, which probably serves as a protection to it, and of which also, perhaps, the scentless mayweed may share the advantage. These two species, however, are nearly allied to one another, and I prefer, therefore, to take as an example of mimicry the stinging-nettle (*Urtica*) and the common dead-nettle (*Lamium album*). These two species belong to totally different families; the flowers are altogether unlike, but the general habit and the form of the leaves are extremely similar.

How close the similarity is may be seen by the illustration (Fig. 21), taken from an excellent photograph made for me by Mr. Harman, of Bromley. The plants on the right are true stinging-nettles; those on the left are the white dead-nettle, one of which is in flower. So close was the resemblance that, after getting the photograph, I went back to the spot on which they were growing to assure myself that there was no mistake. It can not be doubted that the true nettle is protected by its power of stinging; and, that being so, it is scarcely less clear that the dead-nettle must be protected by its likeness to the other. Moreover, though I was fortunate in lighting on so good an illustration as that shown in the figure just when I had the opportunity of photographing it, still every one must have observed that the two species are very commonly found growing together. Assuming that the ancestor of the dead-nettle had leaves possessing a faint resemblance to those of the true nettle, those in which the likeness was greatest would have the best chance of survival,

FIG. 21.

and consequently of ripening seeds. There would be a tendency, therefore, according to the well-known principles of Mr. Darwin, to a closer and closer resemblance. I am disposed to suggest whether these resemblances may not serve as a protection, not only from browsing quadrupeds, but also from leaf-eating insects. On this part of the subject we have as yet, however, I think, no sufficient observations on record.

Ajuga chamæpitys, the yellow bugle, has leaves crowded and divided into three linear lobes, the lateral ones sometimes again divided. They differ, therefore, greatly from those of its allies, and this puzzled me much until one day I found it growing abundantly on the Riviera among *Euphorbia cyparissias*, and I was much struck by the curious likeness. The Euphorbia has the usual acrid juice of the genus, and it struck me that the yellow ajuga was perhaps protected by its resemblance.

Leaves which float on the surface of still water tend to be orbicular. The water-lilies are a well-known illustration. I may also mention *Limnanthenum nymphœoides*, which, indeed, is often taken for a water-lily, though it really belongs to the family of gentians, and *Alisma natans*, a species allied to the plantains. In running water, on the contrary, leaves tend to become more or less elongated.

Subaqueous leaves of fresh-water plants have a great tendency either to become long and grass-like or to be divided into more or less hair-like filaments. I might mention, for instance, *Myriophyllum; Hippuris*, or mare's-tail, a genus which among English plants comes next to *Circæa*, the enchanter's nightshade; *Ranunculus aquatilis* a close ally of the buttercup; and many others.

Some, again, which, when mature, have rounded, floating leaves, have long, narrow ones when young. Thus in *Victoria regia* the first leaves are filiform, then come one or more which are sagittate, and then follow the great orbicular leaves.

Fig. 22.

Another interesting case is that in which the same species has two forms of leaf (Fig. 22)—namely, more or less rounded ones on the surface, and a second series which are subaqueous and composed of more or less linear or finely divided segments.

Mr. Grant Allen has suggested that this tendency to subdivision in subaqueous leaves is due to the absence or paucity of carbonic acid. I have ventured to suggest a different explanation. Of course it is important to expose as large a surface as may be to the action of the water. We know that the gills of fish consist of a number of thin plates, which while in water float apart, but have not sufficient consistence to support even their own weight, much less any external force,

and consequently collapse in air. The same thing happens with thin, finely cut leaves. In still water they afford the greatest possible extent of surface with the least expenditure of effort in the formation of skeleton. This is, I believe, the explanation of the prevalence of this form in subaqueous leaves.

Again, in still air the conditions, except so far as they are modified by the weight, would approximate to those of water; but the more the plant is exposed to wind the more would it require strengthening. Hence, perhaps, the fact that herbs so much oftener have finely cut leaves than is the case with trees. In the *Umbellifers*, for instance, almost all the species have the leaves much divided—more, I need hardly say, than is the case with trees. Shrubs and trees are characterized by more or less entire leaves, such as those of the laurel, beech, hornbeam, lime, or by similarly shaped leaflets, as in the ash, horse-chestnut, walnut.

There are, however, many groups of plants which, while habitually herbaceous, contain some shrubby species, or *vice versa*. Let us take some groups of this description in which the herbaceous species have their leaves much cut up, and see what is the character of the foliage in the shrubby species.

The vast majority of *Umbellifers*, as I have just observed, are herbaceous, and with leaves much divided, the common carrot being a typical example. One European species, however, *Bupleurum fruticosum*, is a shrub attaining a height of more than six feet, and has the leaves (Fig. 23) coriaceous, and *oblong-lanceolate*.

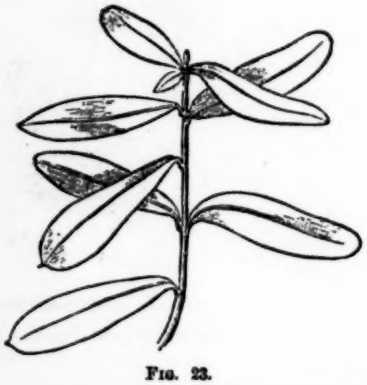


FIG. 23.

FIG. 24.

The common groundsel (Fig. 24), again, is a low herb with much cut leaves. Some species of *Senecio*, however, are shrubby, and their leaves assume a totally different character, *Senecio laurifolius* and *S. populifolius* having, as their specific names denote, leaves respectively resembling the laurel and poplar. In the genus *Oxalis*, again, to which the shamrock belongs, there is a shrubby species, *O. laureola*, with leaves like those of a laurel.

I would venture, then, to suggest these considerations as throwing light on the reason why herbaceous plants so often have their leaves much cut up.*

Next let me say a few words on the reasons why some plants have broad and some narrow leaves. Both are often found within the limits of a single genus. I have ventured to indicate the distance between the buds as a possible reason in certain cases. It would not, however, apply to herbaceous genera such as *Plantago* or *Drosera*. Now, *Drosera rotundifolia* (Fig. 25) has the leaves nearly orbicular,

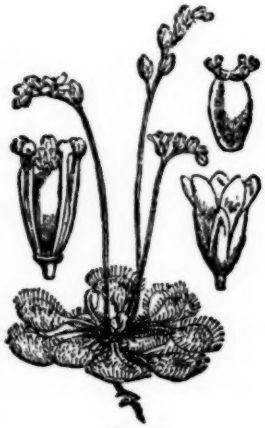


FIG. 25.

FIG. 26.

while in *D. anglica* (Fig. 26) they are long and narrow. *Plantago media* (Fig. 27) has ovate leaves, while in *P. lanceolata* (Fig. 28) they are lanceolate, and in *P. maritima* nearly linear. More or less similar cases occur in *Ranunculus*.

These differences depend, I believe, on the attitude of the leaf, for it will be found that the broad-leaved ones are horizontal, forming a rosette more or less like that of a daisy, while the species with narrower leaves carry them more or less erect. In the daisy the rosette lies on the ground, but in other cases, as in *Daphne* (Fig. 29), it is at the end of a branch.

Any one who has looked with an observant eye at the vegetation of hot, dry countries must have noticed how much the general character of the vegetation differs from that which prevails in a climate like ours. There is a marked increase of prickly, leathery, and aromatic species. The first two characteristics evidently tend to protect the leaves. As regards the third, Mr. Taylor,† in his charming book on

* Mr. Grant Allen, who had been also struck by the fact that herbaceous plants so often have their leaves much cut up, has suggested a different explanation, and thinks it is due to "the fierce competition that goes on for the carbon of the air between the small matted undergrowth of every thicket and hedge-row."

† Page 311.

"Flowers," has pointed to the power which, as Tyndall has shown, the spray of perfume possesses to bar out the passage of heat-rays, and has suggested that the emission of essential oils from the leaves of many plants which live in hot climates may serve to protect themselves against the intensely dry heat of the desert sun.

FIG. 27.

FIG. 28.

I am rather disposed to think that the aromatic character of the leaves protects them by rendering it less easy for animals to eat them.

In still drier regions, such as the Cape of Good Hope, an unusually large proportion of species are bulbous. These, moreover, do not belong to any single group, but are scattered among a large number of very different families: the bulbous condition can not, therefore, be explained by inheritance, but must have reference to the surrounding circumstances. Moreover, in a large number of species the leaves tend to become succulent and fleshy. Now, in organisms of any given form the surface increases as the square, the mass as the cube, of the dimensions. Hence, a spherical form, which is so common in small animals and plants, and which in them offers a sufficient area of surface in proportion to the mass, becomes quite unsuitable in larger creatures, and we find that both animals and plants have orifices leading from the outside to the interior, and thus giving an additional amount of surface. But in plants which inhabit very dry countries it is necessary that they should be able to absorb moisture when opportunity offers, and store it up for future use. Hence, under such circumstances fleshy

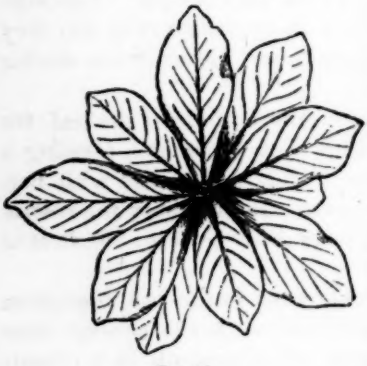


FIG. 29.

stems and leaves are an advantage, because the surface exposed to evaporation is smaller in proportion than it would be in leaves of the ordinary form. This is, I believe, the reason why succulent leaves and stems are an advantage in very dry climates, such as the Canaries, Cape of Good Hope, etc.

The genus *Lathyrus*, the wild pea, contains two abnormal and interesting species, in which the foliaceous organs give the plant an appearance very unlike its congeners. Fig. 30 represents *L. niger*, with leaves of the ordinary type. In the yellow pea (*L. aphaca*, Fig. 31), the general aspect is very different, but it will be seen on a closer

Fig. 30.

Fig. 31.

inspection that the leaves are really absent, or, to speak more correctly, are reduced to tendrils, while the stipules, on the contrary, are, in compensation, considerably enlarged. They must not, therefore, be compared with the leaves, but with the stipules of other species, and from this point of view they are of a more normal character, the principal difference, indeed, being in size.

The grass pea (*L. nissolia*, Fig. 32) is also a small species. It lives in meadows and the grassy borders of fields, and has lost altogether, not only the leaves, but also the tendrils. Instead, however, of enlarged stipules, the functions of the leaves are assumed by the leaf-stalks, which are elongated, flattened, linear, ending in a fine point, and, in fact, so like the leaves of the grasses among which the plant lives that it is almost impossible to distinguish it except when in flower. For a weak plant growing among close grass, a long linear leaf is, perhaps, physically an advantage ; but one may venture to suggest that the leaves would be more likely to be picked out and eaten if they were more easily distinguishable, and that from this point of view also the similarity of the plant to the grass among which it grows may also be an advantage.

In looking at foliage I have often been much puzzled as to why the leaves of some species are tongue-shaped, while others are lobed. Take, for instance, the black bryony (*Tamus communis*) and the common bryony (*Bryonia dioica*). Again, why are the veins in some leaves pinnate, like those of the beech and elm, and others palmate, as in the maple and sycamore?

FIG. 32.

My first idea was that this might have reference to the arrangement of the woody fibers in the leaf-stalk. If we make a section of the stalk of a leaf, we shall find that in some cases the woody fibers are collected in the middle, while in others there are several distinct bundles, separated by cellular parenchyma. My first idea was that each of the primary ribs of a leaf might represent a separate woody fiber in the leaf-stalk, so that leaves with a single bundle of woody fibers would be pinnate; those with several distinct bundles, palmate.

The first species which I examined favored this view. The melon, geranium, mallow, cyclamen, and other species with palmate leaves, had, sure enough, several woody fibers; while, on the contrary, the laurel, rhododendron, privet, beech, box, castanea, arbutus, phillyrea, and other leaves with pinnate veins, had one central bundle. But I soon came across numerous exceptions, and had to give up the idea.

I then considered whether the difference could be accounted for by the mode of growth of the leaf, and I am still disposed to think that it has some bearing on the subject, though this requires further study.

The next suggestion which occurred to me was that it might be connected with the "prefoliation" or arrangement of the leaves in the bud. The first palmate leaves which I examined were what is called "plicate," or folded up more or less like a fan; while the leaves with pinnate veins were generally "conduplicate," or had the one half applied to the other. But, though this was true in many cases, it was not a general rule, and I was obliged to give up this idea also.

It then occurred to me to take climbing plants, and see whether I could find any relation between palmate and tongue-shaped leaves on the one hand and the mode of growth on the other—whether, for instance, the one turned generally up, the other down; whether the one were generally twining and the other clasping, or *vice versa*. All these suggestions one by one broke down.

Among monocotyledons, however, the tongue-shaped preponderates greatly over the palmate form of leaf. With very few exceptions, the

forms of the leaves of climbing monocotyledons are in fact just such as would be obtained by widening more or less the linear, grass-like leaf which is so prevalent in the class.

This, then, raises the question whether the heart-shaped leaf is the older form from which the palmate type has been gradually evolved. Let us see whether we can find any evidence bearing on this question in what may be called the embryology of plants. The furze, with its spiny prickles, belongs to a group of plants which, as a general rule, have trifoliate or pinnate leaves. Now, if we examine a seedling furze (Fig. 33), we shall find that the cotyledons are succeeded by several trifoliate leaves, with ovate leaflets. These gradually become narrower, more pointed, and stiffer, thus passing into spines. Hence, we can hardly doubt that the present furze is descended from ancestors with trifoliate leaves. I have already referred to other cases in which the young plants throw light on the previous condition of the species (*ante*, p. 12).

FIG. 33.

Now we shall have no difficulty in finding cases where, while in mature plants the leaves are more or less lobed and palmate, the first leaves succeeding the cotyledons are heart-shaped. This would seem to point to the fact that when in any genus we find heart-shaped and lobed leaves, the former may represent the earlier or ancestral condition.

The advantage of the palmate form may perhaps consist in its bringing the center of gravity nearer to the point of support. Broad leaves, however, are of two types: cordate, with veins following the curvature of the edge; and palmate or lobed leaves, with veins running straight to the edge. The veins contain vascular bundles which conduct the nourishment sucked up by the roots, and it is clearly better that they should hold a straight course, rather than wind round in a curve. As the nourishing fluids pass more rapidly along these vascular bundles, the leaf naturally grows there more rapidly, and thus assumes the lobed form, with a vein running to the point of each lobe.

On the whole, we see, I think, that many at any rate of the forms presented by leaves have reference to the conditions and requirements of the plant. If there was some definite form told off for each species, then, surely, a similar rule ought to hold good for each genus. The species of a genus might well differ more from one another than the varieties of any particular species; the generic type might be, so to say, less closely limited; but still there ought to be some type characteristic of the genus. Let us see whether this is so. No doubt there are many genera in which the leaves are more or less uniform, but in them the general habit is also, as a rule, more or less similar. Is this

the case in genera where the various species differ greatly in habit? I have already incidentally given cases which show that this is not so, but let us take some group—for instance, the genus *Senecio*, to which the common groundsel (Fig. 24) belongs, as a type well known to all of us—and look at it a little more closely.

The leaves of the common groundsel I need not describe, because they are familiar to us all. This type occurs in various other species of more or less similar habit. On the other hand, the fen *Senecio* (*S. paludosus*) and the marsh *Senecio* (*S. palustris*), which live in marshy and wet places, have long, narrow, sword-shaped leaves, like those of so many other plants which are found in such localities. The field *Senecio* (*S. campestris*, Fig. 34), which lives in meadows and pastures, has a small terminal head of flowers springing from a rosette of leaves much like those of a common daisy (*Bellis perennis*); a Madagascar species, as yet I believe unnamed, is even more like a daisy. *Senecio junceus* looks much like a rush; *S. hypochœrideus*, of South Africa, strikingly resembles a *hypochœris*, as its name denotes. A considerable number of species attain to a larger size and become woody so as to form regular bushes. *S. buxifolius* has very much the general look of a box, *S. vagans* of a privet, *S. laurifolius* of a laurel, *ericæfolius* of a heath, *pinifolius* of a fir, or rather a yew.

FIG. 34.

Again, some species are climbers: *S. scandens* and *S. macroglossus* have leaves like a bryony; *S. araneosus* and *S. tamoides* like a smilax or (yam) tamus; *S. tropæolifolius* like a tropæolum.

Among the species inhabiting hot, dry regions are some with swollen, fleshy leaves, such as *S. haworthii*, from the Cape of Good Hope, and *S. pteroneura*, from Magador. *Senecio rosmarinifolius*, of the Cape, is curiously like a rosemary or lavender.

Lastly, some species may almost be called small trees, such as *S. populifolius*, with leaves like a poplar; and *S. amygdaloides*, like an almond.

I might mention, if space permitted, many other species which, as their names denote, closely resemble forms belonging to other groups —such, for instance, as *Senecio lobelioides*, erysimoides, bupleurioides, verbascifolius, juniperinus, ilicifolius, acanthifolius, linifolius, platanifolius, graminifolius, verbenefolius, rosmarinifolius, coronopifolius, chenopodifolius, lavanderiæfolius, salicifolius, mesembryanthemoides, digitalifolius, abietinus, arbutifolius, malvæfolius, erodiifolius, halimifolius, hakeæfolius, resedæfolius, hederæfolius, acerifolius, plantigineus, castaniæfolius, spiræifolius, bryoniæfolius, primulifolius, and many

more. These names, however, indicate similarities to over thirty other perfectly distinct families.

It seems clear, then, that these differences have reference not to any inherent tendency, but to the structure and organization, the habits and requirements, of the plant. Of course, it may be that the present form has reference not to existing, but to ancient, conditions, which renders the problem all the more difficult. Nor do I at all intend to maintain that every form of leaf is, or ever has been, necessarily that best adapted to the circumstances, but only that they are constantly tending to become so, just as water always tends to find its own level.

But, however this may be, if my main argument is correct, it opens out a very wide and interesting field of study, for every one of the almost infinite forms of leaves must have some cause and explanation. —*Contemporary Review.*

THE FUTURE OF NATIONAL BANKING.

By E. R. LELAND.

THE ever-recurring question as to the methods which should be adopted for supplying the country with currency promises soon again to demand attention, and to be beset with all its old-time perplexities. It is the riddle which is presented in turn to each civilized nation, and, although the penalty of default is severe, no satisfactory answer has as yet been found.

The national banking system, which has frequently been declared to be the best yet devised, can not be said to offer a solution, for, although it served its temporary purpose very well, it lacks, so far as its currency is concerned, the essential element of permanency, being based upon a public debt that, fortunately, is not a perpetuity. Recently grave concern has been felt and expressed over the prospective contraction, if not total withdrawal, of the national-bank circulation which is likely to result from the diminished supply of Government bonds. The prospect is generally deplored. Sundry bills were introduced into the late Congress, looking to a mitigation or postponement of the consequent evils, but no conclusive action was taken, nor is there much reason to expect that the subject will receive serious congressional consideration until it compels attention.

It is true that the advocates of a let-alone policy might justify their course by pointing out that the danger of a currency contraction does not appear so imminent as it did nine months ago. Owing to diminished revenue, there have been no recent bond calls, and the reduction of the debt is for the time arrested. But the prices of bonds have so enhanced as substantially to rob the business of issuing

notes of profit, and, even were the banks willing to keep out their circulation for the small recompense which now comes to them, little reliance can be placed upon a continuance of the present conditions. The reduction of the Government debt will be resumed, nor is the delay likely to give more time than will be needed in which to devise and put into operation some other plan for furnishing a currency supply.

There are many men—so many as to constitute a party considerable in number—who have an ever-ready remedy to administer for this or any similar trouble which threatens our financial system; that is, an additional supply of legal-tender notes. It is not intended here to discuss this proposition. The evils which are certain to attend an unlimited or largely increased issue of legal tenders have so often been shown, and the greenback clamor has so far died away, that there are grounds for the hope, which let us cherish, that a majority will not call for a Government paper circulation, albeit the United States Supreme Court has decided that Congress has uncontrolled power to create and regulate such an issue. For the purpose of this paper, therefore, it will be assumed that resort will not be had to legal-tender notes for a supply of paper money when the bond-secured national-bank notes shall be withdrawn.

There is a school of economists—a title that can not properly be applied to the greenbackers—who hold that it is radically unsound and productive of evil for banks to assume the function of furnishing money; who maintain that there should be no money other than a metallic currency, or one which would in all respects act precisely as a metallic currency acts, because not only based upon but actually representing specie of a like amount deposited and held for its redemption. This school would doubtless regard the time of the retirement of national-bank notes as presenting an opportunity for inaugurating their system too good to be lost. Very recently suggestions in this line have been made and widely considered as, perhaps, offering solutions of both the paper currency and the silver problems; and, indeed, if the experiment were a wise one, it never could be made with less prospect of serious disturbance during the transition period, for the process is already begun by the issue of gold and silver certificates which could be increased, if specie were forthcoming, as bank-notes were withdrawn. If any plan embodying this idea were adopted, we should then have a system somewhat similar to that by which England has been supplied with paper money since the adoption of Peel's act in 1844. Under that act the Bank of England is now authorized to issue notes to the amount of fifteen million pounds sterling upon Government securities; beyond this sum the amount of circulation is determined solely by the amount of bullion which the public chooses to deposit, for the bank is bound to buy gold bullion at the mint price, whenever offered. The banking department and the issue depart-

ment are separately managed, and of the latter the directors have no control. Professor Price says that it is not a department of the bank in any sense; that "it is a self-acting institution of the state, working on the bank's premises, by rules laid down by the state, and absolutely beyond the control of the directors."

If the terms of Peel's act were at all times rigidly adhered to, this description of the operation of the issue department would be correct. As a matter of fact, however, they are not adhered to, but are suspended in times of financial stress, and the directors assume control of the issue department for the relief of the strain upon the banking department and the business community. Three times since the adoption of the act has its operation been suspended. The supposition that a "suspension of the act" involves a suspension of specie payments is, perhaps, still common enough to warrant an explanation of its true nature.

The Bank of England is the custodian of the principal portion of the reserve of all the banks and bankers of England, and to it the latter must look for money to meet the excessive and unusual demands that are made upon them in time of panic. At such times, therefore, a rapid inroad is made upon the bank's supply of gold, and, if the act of 1844 continues in force, a point is soon reached where the directors are compelled, for self-protection, to cease discounting even upon the best securities. Whenever the strain becomes unendurable, an appeal is made to the Government, through the Chancellor of the Exchequer, to suspend the act. If granted, the legal restrictions upon the bank's note-issues are removed, and the directors are authorized largely to increase their issue without reference to the amount of bullion in their vaults; the effect of which is that for the time both departments of the bank are under the management and control of the directors. They are not likely to use this privilege recklessly, for the obligation to redeem their notes in gold on demand remains in full effect. Moreover, for some reason not wholly apparent, it has become a custom—so far as three instances can make a custom—for the Government to stipulate that the bank shall charge a very high rate of interest, say ten or twelve per cent, upon the extra note-issues, the profit thereon to go to the state. The result of this is, that prudence and self-interest combine to make the directors use the powers conferred upon them most sparingly, and they do so. In but one instance has there been an over-issue. This was in 1857, and to the extent of eight hundred thousand pounds. In 1847 and in 1866 the fact of suspension proved sufficient to allay the panic and to avert, at least, its worst consequences.

A recent writer recommends the mechanical and local separation of the issue department from the Bank of England to a Government office, as tending to the propagation of clearer ideas on the subject of note currency. No suggestion is offered as to the way in which relief could be afforded in emergencies similar to those which have hereto-

fore been met by extending the bank's powers, nor is it obvious how any could be given except through the agency of the bank.

Extending the comparison between the English system and that of the United States, with the national-bank notes retired, the legal tenders, although much greater in volume, might be likened to the seventy-five million dollars that the Bank of England issues against its securities, while the bank's specie-secured issues would find their parallel in the gold and silver certificates. These now amount to something more than two hundred and fifty million dollars. They have not very far to go before they would equal the national-bank notes outstanding, and the expediency of largely increasing the issue is freely discussed.

But in the workings of the two systems here compared there would be an important difference.

When the act of 1844 was being urged, its advocates recognized that in extreme cases a rigid adherence to its provisions might be mischievous, and special governmental interference be found necessary. Experience has shown that such compelling emergencies do arise. Warned by this, Mr. Lowe, Chancellor of the Exchequer, introduced into the House of Commons in 1873 a bill providing for automatic suspension, so to speak. He proposed that the Government might lawfully suspend the bank act when certain conditions obtained, conditions presumed to be indicative of a panic; but the bill was not received with favor, and was withdrawn. What the effect of a strict adherence to the act in time of panic would be, it is difficult to predict—it has never been tried.

It is not easy to see how, even if it were made lawful, relief could be given in the case of a strictly governmental issue, consisting, for example, of specie certificates and legal tenders. If additional issues of the latter were authorized, how, in time of peace, would they be put afloat? Certainly few would be willing to have the Treasury Department take up the business of banking and make advances on miscellaneous securities. But the time would certainly come when the temporary relief given by clearing-house certificates would be found to be, or at least be thought to be, inadequate, and an increase of currency be demanded. Could there be any assurance that the power to make such increase resting in Government officials would be exercised with the caution shown by the Governor and Company of the Bank of England, who are restrained by considerations both of prudence and profit? An illustration of the course likely to be pursued was furnished in 1872–'73, when forty-four million dollars of legal tenders, which had been retired by Secretary McCulloch, were dubbed a reserve, the reissue of which was demanded and granted to the extent of twenty-six million dollars. There are ample grounds for the fear that any system under which the Government should furnish, in whatever form, the whole supply of the paper money of the country, would keep us constantly on the lee-shore of an inconvertible paper currency,

the capacity of which for working mischief has often been pointed out.

It is not probable, however, that there will be any wide departure from existing methods. Outside of the straggling ranks of the greenbackers the national-bank notes are regarded with favor. It can not be gainsaid that the period during which they have been in existence has been a very comfortable one, so far as a good currency for the people could make it so. Whatever theoretical objections there may be to the system, it has worked singularly well, is justly popular, and it is easy to understand why its probable restriction and ultimate discontinuance should be looked forward to with concern.

There has been little or nothing in the way of suggestion as to what can be done to perpetuate the national-bank issues. Various plans have been proposed for prolonging their existence; but closely adhering, as all these plans do, to the theory of a bond-secured currency, they are confined within narrow limits.

Secretary Folger and Secretary McCulloch, Comptrollers Knox and Cannon, have substantially agreed in their reports for two years past in recommending—1. The removal of the tax on bank circulation; 2. An increase of the percentage of currency which the banks may issue against bonds deposited; 3. The conversion of long bonds into three, or two and a half per cents, the latter being less likely to be withdrawn for reasons having no reference to the amount of circulation needed; and bills were introduced in both Houses of the last Congress providing for the practical application of these recommendations. Their adoption would, however, afford but temporary relief. It would have the merit, no small one it may be said, of enabling us to travel along the well-known road for a while longer, but it would only postpone the day when a solution of the currency problem must be confronted.

The true solution has, by some of the gentlemen referred to, been declared to be a reduction of the redundant revenue sufficient to retard the retirement of bonds, and finally to arrest it when their volume shall have reached, or closely approached, the amount requisite to secure the national-bank circulation.

To retard the payment of the public debt by reducing taxation would probably be expedient, it certainly would be popular; but wholly to arrest payment, and, for such a purpose, maintain the debt at a fixed sum, would be another and a very questionable matter. Moreover, a currency thus regulated as to volume would lack the important element of adaptability, or, as it is sometimes called, elasticity, for it is not likely that any one would go so far as to suggest that the bond debt should be increased and decreased in accordance with the demands for currency—a method which, if not otherwise questionable, would be so clumsy and tardy in its operation as to serve but poorly. Who in such case should decide what amount of cur-

rency and consequently of bonds would be needful? The Secretary of the Treasury or the congressional committee who should be called upon to determine this point would require the same degree of omniscience that would be required to fix the proper limit of irredeemable legal tenders. The objections to any arbitrary regulation of the volume of currency have been so often pointed out as to make needless their recital in this connection.

To maintain, for the purposes of bank-note security, a Government debt anything in excess of the Government's needs, would be, in effect, to levy a tax upon the community at large for distribution as a bounty on bank-note circulation. It may be said that the benefits inuring to the issuers would be slight and incidental—a not undue reward for the service rendered—and that the real purpose would be the protection of the note-holder, which protection would be worth more than its cost. Thus stated, the proposition would be to make the note-holders a preferred class of creditors, secured at the public cost. It would be pertinent to ask here, By what logical method is the conclusion reached that this preference should be given to the note-holders alone? Are there not other classes of creditors with equal claims for protection? The depositors in savings-banks, the beneficiaries of life-insurance policies, and divers other corporate and private trusts, are now very largely secured by Government bonds, and it is not easy to see why, if the note-holders are to have special protection, these can not with perfect justice ask that they too shall continue to be cared for by the Government. That such demands should be acceded to few will assert, but it would be quite as proper for the Government to furnish security for all as for a part. But it is idle to discuss this proposition at length. Whatever differences of opinion there may be as to the rate at which reduction of the debt should go on, there is little difference as to the general principle that it should be reduced as fast as may be consistent with a proper distribution of the burden. The proposition that it is a good thing to pay one's debts, when abundantly able to do so, is sound, and it applies to an aggregate of individuals—the state—precisely as it does to a single individual. Public opinion will doubtless demand, it certainly would be right in demanding, that the volume of the public debt shall be regulated without reference to national-bank-note issues; the idea that it should, or might with propriety, be regulated with reference to their needs, is radically unsound. Nor, it may be added, are there any reasons, economic or political, for a resort to such strained methods.

That a paper currency is one of the requirements of a great commercial country is generally admitted. That such a currency can best be furnished by banks of issue, if not so generally admitted, would seem to be demonstrated by universal custom among civilized nations. The issuance of circulating notes is a legitimate, if not necessary, function of the business of banking. It is one of the forms of the compli-

cated system of credit which has made commercial growth possible, nor is there any reason why this particular form of banking obligation, constituting, as it does, but a minor part of the total, should, when created, have other or better safeguards than the remainder. The security furnished by the capital of the banks, by the ability and integrity of their management, aided by governmental supervision, which must needs serve for the greater part of their liabilities, should be adequate for the whole. The checks and precautions, the discrimination, which are applied to the use of credit in other branches of banking, the protection which is found to answer for depositors and holders of checks and drafts, should also be sufficient for the holders of that particular class of "memoranda of claims" known as bank-notes. That this protection can be made practically efficient is amply proved by the history of the national banking system in the United States. During an experience of more than twenty years the average annual loss to depositors has been only one twentieth of one per cent of the total.

The public have become so accustomed to the use of a bond-secured currency, and have so generally credited the satisfactory results to the feature of special security, that the suggestion of an unsecured currency, or, rather, a currency not secured by special deposits, is not likely, at the outset, to be received with favor. To many it will recall the days of wild-cat banking, when the country was flooded with money that was practically irredeemable, and wide-spread and serious loss was inflicted on the community, especially upon the poorer classes, by having worthless issues forced upon them. But there is little danger and no need of a revival of that vicious system.

The lessons of the past have not been wasted; nor are we a "nation of rascals," in spite of sundry recent revelations of rascality and weakness. More and more, as civilization advances, does the tendency of people to trust each other increase. Yearly the average of prudence and trustworthiness grows larger. If not because of a stronger sense of moral obligation, then because of a better appreciation of the necessity therefor in the conduct of business, men show a growing respect for each other's rights, and place a greater reliance upon the relations of contract.

Mr. Spencer says, "Given a nation of perfectly honest men, and nearly all trade among its members may be carried on by memoranda of claims." We have not, it is needless to say, reached an ideal state of perfect honesty—far from it. The adoption, therefore, of an absolutely free banking system, without limitations or restrictions, would be an experiment too hazardous to be tried. There is, however, a degree of honesty which suffices to maintain a credit system of great extent and complexity, involving the use of enormous sums of promises to pay, and the extension of that system to cover the use of the particular form of promises to pay known as bank-notes is logical, natural, and, with proper restrictions, safe.

It is true that notes which pass from hand to hand as money are not scanned as closely as are other evidences of debt, nor can there be the same discrimination exercised in their use. They must, if circulated in small denominations, of necessity be taken by many who have no means of forming correct conclusions as to the soundness of the issues, and who can least afford to suffer loss. But the circulation of small notes of any sort is to be deprecated. Adam Smith pointed out the difference in the forms of money required for dealers and for consumers; that for the uses of the latter, paper money is not fitted, no matter what its form or security. The soundness of this view has been largely discussed since his time, but the preponderance of opinion has been in its favor. Mr. McCulloch, in his recent report, recommended the discontinuance of small notes. It would bring out a large amount of silver and small gold, which furnish the best kind of money for the smaller transactions of trade, and afford the best possible protection for the small dealers, the wage-earners—men, women, and children—who suffer most from a defective currency.* If small notes were retired, the smaller savings, the stocking-hoards, would consist of gold and silver, and obviously it is best that this part of the country's reserve—no inconsiderable part—should be of specie. The aggregate issue of legal-tender and national-bank notes of denominations under ten dollars is about two hundred and twenty million dollars. It is probable that nearly this entire amount could be replaced with gold and silver before the point of specie saturation would be reached. Such a volume of hard money would supply the best obtainable guarantee against currency disturbances.

That, if relieved from the function of furnishing wage and pocket money, a bank currency, suited for the larger operations of trade, and yet not handicapped with the obligation of special bond deposits, could be established with safety, may be asserted. That banks of issue can be safely conducted and furnish a sound currency has been sufficiently shown under conditions far more unfavorable than now obtain in the United States. The Scotch banks are examples. So well have they been conducted that Professor Jevons admitted that their system would be an excellent one for general adoption, "if we were all Scotchmen." It may be fairly doubted, however, whether the satisfactory results in Scotland are wholly due to exceptional integrity, sagacity, and caution on the part of Scottish managers. May it not be that the bank-currency system, properly conducted, has had a fairer trial in Scotland than elsewhere?

One does not need to be very old to remember when this country, especially the West, was dependent upon a paper currency that was, for the most part, of a very trashy kind; and to remember, also, that

* That the forced circulation of a debased coinage, by this or any other method, is not intended to be advocated, need hardly be explained; but a discussion of the silver question is no part of this paper.

even then, and in that region, there were notable exceptions. Bank officials will remember how a stray note of the ugly issues of the State Bank of Indiana, or the Wisconsin Marine and Fire Insurance Company, coming in with a pile of gaudy wild-cats, used to "shine out like a good deed in a naughty world," and was promptly sorted out and laid away as a part of the reserve. Those banks, with a few others, having relatively very large issues, were conducted safely through the vicissitudes of those days, promptly redeeming their notes on the advent of the national system without the loss of a dollar to the holders. But the honestly and prudently conducted banks of that period were not numerous nor strong enough to redeem the vices nor avert the evils of paper-money banking as it was then carried on. The story of recklessness, fraud, and suffering does not need to be retold, and no one would be willing to see the way opened for a repetition of its experiences.

The conditions now are very different. The operation of the national banking system for twenty years has brought to its management a class of trained and educated bankers, who are, for the most part, fit custodians of the people's money, and to whom might be intrusted the work of furnishing paper money for the country with greater economy and less risk of loss than would attend the adoption of any other system. The machinery is at hand, is in excellent working order, and would need but slight modifications to fit it to perform its work after the obligation to deposit Government bonds against note-issues had been canceled. There are now over twenty-six hundred national banks in operation. They have been organized and located, not with reference to issuing currency, but to supply the legitimate needs of the business community. To guard against the formation of banks for purposes of circulation only, the right to issue might for the present be confined to those now in existence, with a permanent provision that such right should be extended to new banks only after three or five years of successful operation: no permits to be granted except under the conditions now imposed as to location, ratio of capital to population, and of circulation to paid-up capital. A Government bureau should continue its supervision, and should engrave, print, and furnish the note impressions as a precaution against the possibility of over-issues; this and any other labor or expense imposed upon the bureau to be paid for by a continuance of the tax on currency. Existing regulations as to reports, examinations, and control in cases of bankruptcy should be maintained, and it might be well to give preference to the claims of note-holders. Notes should, of course, be redeemed in coin or legal tenders on demand, with provision for central redemption. At present there is, practically, no redemption except of mutilated notes. Under the system suggested redemption would be real, and the amount of note circulation be, as it should be, regulated by trade requirements, with no danger of a sudden and un-

necessary increase, such as has been seen in the former history of free banking.

The question of the constitutional power of Congress to authorize such a system can only be alluded to. It would very likely be raised; but it may be assumed that it would not prove an insuperable objection. It might be made a condition of granting charters or licenses to banks that they should be required to lend a certain percentage of their capital to the Government whenever called upon, and also under proper restrictions be made depositories of public moneys; thus, as has been suggested, doing away with the expensive and primitive system of local sub-treasuries.

Bankers to make money on their issues must keep them in circulation, which could be done by the same means, and those only, that are employed to build up a line of deposits; that is to say, they must establish their credit by promptly performing their engagements. Governmental interference should be exercised solely with reference to insistence upon such performance.

That in some cases there would be mismanagement, dishonesty, and consequent loss, in the future as in the past, is certain; but the control and supervision of banking should not, any more than that of other branches of business, be regulated upon the hypothesis of fraud. The losses which might come would be comparatively small, would follow quickly upon their causes, would have the advantage of being directly traceable, and so permit the prompt application of remedial measures. With the existing means of swift communication, with the wide distribution of national banks, and the watchfulness which they employ toward each other, and, finally, with the smaller transactions carried on by means of specie, the losses upon bank-notes would not only be small, but would, for the most part, fall upon the banks themselves, they being the constant custodians of the greater part of the currency; and they could be trusted to see to it that only such circulated as was worthy to have circulation.

This brings us to a suggestion which is put forth with much hesitation, and only as a suggestion, notwithstanding it is believed that it is sound in principle, and might be made safe in practice. It is simply that the banks should assume the risk, and, as a whole, undertake to protect the rest of the community from loss upon note-issues. To effect this it would only be necessary, so far as legislation is concerned, to continue in force that provision of the existing law which makes national-bank notes a legal tender to national banks. It would seem to be well-nigh certain that the banks could assume this risk of loss, whatever it might prove to be, and still the business of issuing notes afford a larger margin of profit than it now does. For this would be but an application of the insurance principle to one class of the accidents to which the banking business is liable. The banking interest, as a whole, would undertake to indemnify the public against losses

arising from the failure of individual banks to redeem their notes. As to the nature and extent of such losses, they already have a much better basis for estimating them than was available to life or fire and marine insurance companies in their inception. A perfectly trustworthy "table of experience" is supplied by the record of the losses to depositors in national banks for the last twenty years; these, as before stated, have been only one twentieth of one per cent per annum. This interval covers two periods of panic and consequent depression, and may be presumed to have included most, if not all, of the vicissitudes of the business. If from abundant caution the estimate of probable loss should be put at tenfold that which past experience with the national system has shown, and the present Government tax on currency be added, we should have a total of one and a half per cent on the volume of currency to cover losses and expenses. The premium out of which to pay this charge would be the interest on the excess of the average amount of currency in circulation over the reserve required to be held against it, or say from three to seven per cent, varying with the state of the money market and the location of the banks. This certainly offers an ample margin.

The idea is not altogether novel even in its application. It was adopted in the case of the various branches of the State Bank of Indiana, and worked satisfactorily. Slightly modified, it is applied by the guarantee companies, which, for a much smaller premium, guarantee employers against the fraud and insolvency of their servants. The suggestion may be somewhat startling to bankers, who, as a class, are proverbially and properly conservative, but the soundness of the principle which underlies it has been demonstrated by long experience and is constantly finding wider application. Bankers daily risk, without thought of fear, far larger sums than such an insurance of currency would involve upon guarantees that are much less stable, that is upon the indemnity furnished by insurance companies, which, both as regards sums at risk and premiums charged, conduct their business on comparatively small margins. Should the liability seem too great if extended commonly to all the banks, geographical districts might be created with redemption centers, the mutual guarantee of the banks not to extend beyond the limits of their districts.

Objection may be taken that such a system of currency would increase the profits of banking. That it would do so, in some degree, is probable, but it is not in the interest of that business that the suggestion is made. The public have the deepest interest in the avoidance of perturbations or disturbance in the currency supply. If the principles presented be sound, and their application correct, it would seem to be clear that the existing banks could continue their present circulation, and guarantee it, with safety to themselves and their noteholders; and that thus might be accomplished the desideratum of paying off the Government bonds, when the time comes, without can-

celing the bank circulation. If, later, need should arise for a greater volume of currency, arrangements might be devised for increasing the circulation of existing banks or creating new ones. Obviously, the banks themselves should, in such event, have a voice in determining the methods by which this should be done, and in the selection of the persons or corporations to whom the right of issue should be extended. Similarly, in regard to examinations; thoroughness should be assured, nor need this be difficult. When the banks of a clearing-house are called upon to care for some embarrassed member, a brief inspection enables them correctly to determine the real condition of the applicant; they have a direct interest in getting at the facts. Examiners should be chosen, or at least nominated, by the banks.

The bureau which supervises the other operations of the banks could, with but little addition of labor or responsibility, conduct the redemption of the notes of insolvent banks, and levy and collect whatever assessments might be needed to make good deficiencies.

But it is needless to enter into an elaboration of details; they would present no serious difficulties when, if ever, it became necessary to deal with them.

It may be said of any suggestions in this connection, that, whatever opinion may be held of their worth, they are not premature, nor without value, if they provoke the attention of men who are able to do better thinking. The occasional desertion of national banks to the ranks of state institutions, and the contemplated separation of others, as well as the prospect of enforced relinquishment of circulation by all, indicate, plainly enough, that it is none too soon to consider some modification of the national banking system, if it is to be maintained, and it has worked too well to be needlessly abandoned.

It would probably be assuming too much to expect that any system of bank issues without special security, however surrounded by safeguards, would find present favor with our national legislators, or indeed secure many adherents. A few years ago, some of our ablest financiers, both in and out of Congress, predicted that free banking would follow swift upon the resumption of specie payments; but present indications do not point that way. More crude and less scientific expedients are likely first to be tried—and to fail. But it seems not over-presumptuous to predict that ultimately resort will be had to some form of that system. Its convenience and economy are obvious, and will assert themselves. The evils which it involves are such, and such only, as are inherent in the general conduct of business, such as will inhere so long as honesty and mutual confidence are imperfect; as these improve, the risks will lessen. While the causes exist, the losses will fall; there can be no perfect safeguards, nor of such as are possible can a paternal government afford the best: they must be looked for at the hands of the people themselves.

THE MECHANICS OF HANGING.

By JAMES BARR, M. D.

AS the subject of the mode of carrying out executions has recently engaged public attention, the present is perhaps an opportune time for discussing the question in its scientific and humane bearings, so that some more definite ideas may prevail as to the best method of hanging, and that the details may not be entirely left to the caprice of the executioner. When the law requires the death-sentence to be meted out at the end of a hempen rope, the dictates of humanity demand that all the details should be carried out in "decency and in order," and with a minimum amount of suffering to the culprit, and from this stand-point I shall treat the subject.

The mode of carrying out the sentence of the law, "be hanged by the neck until you are dead," has usually been left to the discretion of the hangman, the law taking no cognizance as to what is to be the proximate cause of death. Calcraft invariably adopted the short drop of about two feet and a half; and if I may judge from some specimens of his ropes, which are still to be seen at Kirkdale, death must have been produced by a slow process of asphyxia. Marwood adopted what is generally known as the long drop, of which he was supposed by many to be the originator, though it was used long before his time, both in Paris and in Ireland.

To Professor Haughton we are indebted for a scientific exposition * of the *rationale* of the long drop, and of the mode in which death takes place. Dr. Haughton also gives an elaborate explanation of the American method, which is a scientific modification of the old naval method of running the culprit up to the yard-arm.

Having now briefly referred to the different modes of hanging which have been adopted in executing criminals, we will be better able to judge which is the best and most practical method when we have considered the various causes of death. Professor Tidy † says that "in hanging, as in drowning, death does not always take place in exactly the same way. Thus, it may result from—(1) asphyxia; (2) cerebral hyperæmia; (3) a combination of asphyxia with apoplexy; (4) syncope; (5) injury to the spinal cord and pneumogastrics (neuro-paralytic death)."

Professor Hoffmann, ‡ of Vienna, says that, "in hanging, the noose does not press directly on the larynx and the trachea, but almost always slips between the larynx and the chin. In these cases the basis of the tongue is pushed upward, and pressed against the posterior wall

* "Principles of Animal Mechanics," 1873. † "Legal Medicine," part ii, p. 385.
‡ "British Medical Journal," December 21, 1878, and May 10, 1879.

of the pharynx, completely closing it. The most important agent, however, in this kind of death is the compression of the larger vessels and the cervical portion of the vagus nerve, the upper portion of the carotid being pressed against the transverse processes of the cervical vertebræ before it branches off into the external and internal carotids, and the inner coat of the vessel being ruptured. The jugular veins are compressed at the same time, and the brain can neither receive any more blood nor allow that which it contains already to flow away; its irritability is therefore extinct. The very important part which both the vagus and the vessels take in causing death by hanging is clearly shown through the following observations: 1. Loss of consciousness following immediately the compression caused by the rope at the moment when the noose is drawn tight by the weight of the body. The truth of this assertion is proved by the fact that no person who commits suicide by hanging ever attempts to rid himself of the rope which throttles him, although he might do so easily by standing upright, as the body is not always suspended above the surface of the ground. 2. The rapidity with which death ensues and the beating of the heart stops. The few struggling respirations which generally occur in asphyxia shortly before death have not been observed in persons who have been hung. It is also well known how difficult it is to restore such patients to life. Death by hanging is, then, complex. It results from the occlusion of the respiratory tubes, from the sudden interruption of the passage of blood into the brain, and possibly from arrest of the circulation determined by the compression of the vagi nerves." These observations of Professor Hoffmann obviously refer to cases of constriction of the neck without dislocation of the vertebræ, and show how death should take place rather than how it does in cases of the short drop. The constriction of the neck is not usually so complete as he has assumed; the carotids are not completely obliterated, as shown by the pulse in the temporal artery, and by the gradual increasing congestion of the head—owing to the obstruction to the venous return—until at last the tongue is protruded out of the mouth; nor is the vagus much pressed upon, as evidenced by the long continuance of the heart's beats in many cases. It shows rather a paucity of reasoning to infer immediate loss of consciousness because no suicide "ever attempts to rid himself of the rope which throttles him." A suicide is a very unlikely individual to change his purpose during the short period which elapses between suspension and loss of consciousness.

Dr. Taylor* states that "death from hanging appears to take place very rapidly, and without causing any suffering to the person. Professor Tidy, also, speaks of the painless nature of death from hanging; while Professor Haughton, in his paper read before the Surgical Society of Dublin, says that "the old system of taking a convict's life

* "The Principles and Practice of Medical Jurisprudence," 1865, p. 651.

by suffocation is inhumanly painful, unnecessarily prolonged, and revolting to those whose duty it is to be present." Those who speak of the painless nature of death by strangulation arrive at this conclusion from the fact that many cases of suicide are not completely suspended, and that if they wished they could easily relieve the constriction by assuming the erect posture, and in other cases of recovery from attempted suicide by hanging there is no recollection of any suffering. It should be remembered, however, that there is a great difference between the mental attitude of the suicide and one who is about to suffer the extreme penalty of the law. In the former case he is regardless, and perhaps also not very sensitive, of a little suffering, while in the latter every nerve is braced up to resist the inevitable result. Moreover, in those cases of recovery the loss of recollection of suffering does not prove that there was none. It might almost as well be said that, because in many cases of recovery from meningitis there was no remembrance of any suffering, therefore there was none. No doubt, the pain in hanging can under no circumstances be very acute, yet when we see a culprit heaving his chest and almost raising the whole body in his struggles for breath we must conclude that there is at least a considerable amount of mental torture.

While death from asphyxia as ordinarily brought about by the short drop is a barbarism which should not be tolerated in this humanitarian age, yet it might be accomplished without much suffering. If this mode of death be determined upon, then the constriction should be complete, and the compression of the blood-vessels, both veins and arteries, and if possible also the nerves, is of even more importance in the production of rapid unconsciousness than the occlusion of the windpipe. In accomplishing this object the position of the noose is of importance; it should never be placed over the larynx, as the rigidity of that organ prevents complete compression and also shields the blood-vessels. Below the larynx would perhaps be the best position, but then there would always be the danger of the noose shifting up to the least desirable spot, therefore the most suitable position would seem to be between the hyoid bone and lower jaw. The rope should be thin and pliable, and not very elastic (a silk rope would perhaps be the best), the ring should be placed under the lower jaw, and the drop should be long enough to compress windpipe, blood-vessels, and nerves. If a half-inch silk rope were used I should think a drop of from four to six feet, according to the weight of the prisoner, would be sufficient. As to deaths from cerebral hyperæmia, and its combination with asphyxia, they are merely modifications of the latter form of death, and result from incomplete constriction, the windpipe not being quite occluded, while the venous return is obstructed, but not the arterial supply. They are thus rather slow forms of death, and consequently not desirable. Death from syncope may be associated with any mode of hanging, but is perhaps most frequently connected with the long

drop. It is about the most rapid and least painful, though perhaps the rarest form of death. In a case of syncope, I have seen the heart's action cease in two minutes from the time the bolt was drawn. Fear largely contributes to this mode of death.

It now remains for us to consider death by dislocation or fracture of the cervical vertebræ, with consequent laceration of the spinal cord. It is frequently supposed that the injury arises from rupture of the transverse ligament of the atlas and pressure on the cord by the odontoid process, but, if ever this does occur, it must be extremely rare. Rupture of the transverse ligament could only take place when the rope was adjusted very high in the neck, with the ring directly in front or behind. And even then the odontoid process would be more likely to break than the ligament. The destructive effect occurs at the point on which the strain is brought to bear, and so the seat of injury varies in different cases. I have seen it take place in the following situations: Complete separation between the second and third cervical vertebræ and fracture of the odontoid process at its junction with the body of the axis; oblique fracture through the body of the axis, leaving the upper fragment with attached odontoid process *in situ*, and fracture of the arch separating it from the body of the axis; complete separation between the second and third cervical vertebræ above the intervertebral disk, also slight separation and tearing of ligaments between the atlas and the axis; and complete dislocation between the fifth and sixth cervical vertebræ. In this latter case the ring hitched on the chin, and the opposite part of the noose was low in the neck, so that the long leverage action determined the low position of the injury. In every case the vertebræ were separated at the point of injury for at least an inch, the spinal cord was severed, and the vertebral arteries and all the ligaments were torn across.

The shock to the nervous system produces an immediate loss of consciousness, with complete paralysis of all the voluntary muscles. It takes a body moving under the influence of gravity three quarters of a second to fall through the space of nine feet; and, owing to the velocity acquired, according to the law of uniformly accelerated motion, the time occupied in the last seven inches—during which the stretching and tightening of the rope occurs—is only ·0225 of a second. If to this we add, say, ·0275 for the elasticity of the rope, then the whole time during which the shock could be felt is only ·05, or one twentieth of a second. Even from this we must deduct the time which it takes for the nervous impression to travel to the sensorium and back, but, as the nerve-current travels at the rate of one hundred feet per second, this is so slight that, like the atmospheric resistance to the falling body, it may be left out of account. Although loss of consciousness, and it is with this that humanitarians are chiefly concerned, is instantaneous, yet death, as evidenced by the cessation of the heart's action, does not take place so rapidly. It is possible in

some cases that the cardio-inhibitory center may be stimulated, or the vagi compressed, so as to immediately arrest the beat of the heart, yet I am convinced that this is the exception, and not the rule. The respiratory and vaso-motor centers are at once paralyzed. I have never seen even the faintest involuntary gasp, and the arteries feel at once to have lost tone. The excito-motor ganglia of the heart keep up its action, in the majority of cases, for some minutes independently of the central nervous system, and its arrest is probably brought about by a process of asphyxia. The immediate cessation of all respiratory movements deprives the heart of all assistance in carrying on the circulation, and prevents the lungs from becoming surcharged with blood, as in ordinary cases of asphyxia, but the other signs of death from that cause are usually present, such as turgescence of the right side of the heart and general venous system ; great lividity of the face ; swelling, and perhaps protrusion, of the tongue. It should be remembered that these latter signs are best observed during suspension, because when the body is taken down hypostasis occurs quickly owing to the great fluidity of the blood, the tongue recedes within the mouth, and the general lividity on the upper surface of the body disappears, to reappear in the most dependent parts. The right side of the heart soon becomes incapable of driving the unoxidized blood through the lungs ; the left ventricle at first readily propels the blood into the lax arteries, but soon the supply is diminished and the contraction becomes feeble, and at the same time the blood is accumulating in the venous system, and thus tending to equalize the pressure, and so at last the left ventricle is unable to drive its modicum of blood through the systemic capillaries. We have thus at the same time both sides of the heart unable to perform their work, and cessation of the cardiac action is the result. The time during which I have observed the heart's action after dislocation of the cervical vertebræ has ranged from two to thirteen minutes. As Professor Haughton has shown, the destructive effect on the neck of the criminal is in proportion to the *vis viva* which is acquired by the weight of the culprit and length of the drop ; and, if the drop be long enough, the vertebræ are certain to be dislocated, no matter what be the position of the ring or thickness of the rope. The *vis viva* in any case is equivalent to half the mass multiplied by the square of the terminal velocity. Let W represent the weight of the criminal, and S the length of the drop, then the formula will be :

$$\frac{1}{2} M V^2 = \frac{1}{G} \frac{W}{2} 2 G S = W S,$$

or the weight of the criminal multiplied by the length of the drop expresses in foot-pounds the amount of work expended on the neck of the criminal. I have not complicated the formula with the co-efficient of the elasticity of the rope—which is very slight—as we will devote some attention to the character of the rope further on. I would now

modify Dr. Haughton's rules by substituting, say, 1,260 foot-pounds for 2,240. If the neck of the criminal be small and delicate, or the rope very fine, then it would be well to calculate on a lower basis—say, 1,120 foot-pounds. Thus, a man weighing 140 pounds would require a drop of nine feet ($1{,}260 \div 140 = 9$), and one weighing 120 pounds should have ten feet and a half ($1{,}260 \div 120 = 10\frac{1}{2}$). The rope should not be too thick nor too elastic, otherwise the abrupt shock will be broken, and the advantages of the long drop lost; but, on the other hand, it should not be too thin nor too inelastic, as then there is not merely the risk of the rope breaking, but also of snapping the head off the culprit. The rope should be of the finest and best hemp, pliable, and capable of bearing a strain of at least a ton and a half. About three fourths to seven eighths of an inch in diameter will be found a convenient thickness, and every rope should be tested before being used. I have been told by the master of a ship that, if in the manufacture of the rope the hemp be run through oil, it makes the rope much more pliable. It would certainly prevent it from becoming stiff when exposed during a wet morning. The iron hooks and couplings to which the rope is attached should be inspected on each occasion.

There has been a great difference of opinion regarding the position of the ring; Professor Haughton recommends that it be placed under the chin, while Dr. Barker, of Melbourne, would have it on the nape of the neck. When the ring is placed in the latter position, the chin naturally falls forward on the sternum, and the rope has no leverage action whatever to assist in dislocation; and, moreover, the noose does not tighten well on the neck, but the ring lies against the occiput; so this position is not only the worst for producing luxation, but also for strangulation. When the ring is under the jaw or chin there is a leverage of several inches, the head is thrown back or to one side, and the noose firmly constricts the neck. In the stretching of the rope the noose tightens several inches; if, therefore, the ring be placed under the angle of the lower jaw on either side, and directed forward, it will be drawn under the chin in the act of tightening. The noose should be placed as high in the neck as possible, and drawn just sufficiently tight to prevent it slipping out of position while the body is falling.

If those in authority would lay down a few simple rules as to the manner in which executions should be performed, then it would not require much *science* to carry them out. These rules might perhaps also have the effect of relegating the executioner more into obscurity, and dispel all illusionary ideas as to his being the possessor of a *mystic* craft, or one to be fêted by the populace and interviewed by the press in order to satisfy a morbid public taste.—*Lancet.*

DIET IN RELATION TO AGE AND ACTIVITY.

By Sir HENRY THOMPSON.

[*Concluded.*]

ANOTHER agent in the combination to maintain for the man of advancing age his career of flesh-eater is the dentist. Nothing is more common at this period of life than to hear complaints of indigestion experienced, so it is affirmed, because mastication is imperfectly performed for want of teeth. The dentist deftly repairs the defective implements, and the important function of chewing the food can be henceforth performed with comfort. But, without any intention to justify a doctrine of final causes, I would point out the significant fact that the disappearance of the masticating powers is mostly coincident with the period of life when that species of food which most requires their action—viz., solid animal fiber—is little, if at all, required by the individual. It is during the latter third of his career that the softer and lighter foods, such as well-cooked cereals, some light mixed animal and vegetable soups, and also fish, for which teeth are barely necessary, are particularly valuable and appropriate. And the man with imperfect teeth who conforms to Nature's demand for a mild, non-stimulating dietary in advanced years will mostly be blessed with a better digestion and sounder health than the man who, thanks to his artificial machinery, can eat and does eat as much flesh in quantity and variety as he did in the days of his youth. Far be it from me to undervalue the truly artistic achievements of a clever and experienced dental surgeon, or the comfort which he affords. By all means let us have recourse to his aid when our natural teeth fail, for the purpose of vocal articulation, to say nothing of their relation to personal appearance: on such grounds the artificial substitutes rank among the necessaries of life in a civilized community. Only let it be understood that the chief end of teeth, so far as mastication is concerned, has in advancing age been to a great extent accomplished, and that they are now mainly useful for the purposes just named. But I can not help adding that there are some grounds for the belief that those who have throughout life from their earliest years consumed little or no flesh, but have lived on a diet chiefly or wholly vegetarian, will be found to have preserved their teeth longer than those who have always made flesh a prominent part of their daily food.

Then there is that occasional visit to the tailor, who, tape in hand, announces in commercial monotone to the listening clerk the various measurements of our girth, and congratulates us on the gradual increase thereof. He never in his life saw you looking so well, and "fancy, sir, you are another inch below your armpits"—a good deal

below—"since last year!" insidiously intimating that in another year or so you will have nearly as fine a chest as Heenan! And you, poor deluded victim, are more than half willing to believe that your increasing size is an equivalent to increasing health and strength, especially as your wife emphatically takes that view, and regards your augmenting portliness with approval. Ten years have now passed away since you were forty, and by weight twelve stone and a half—a fair proportion for your height and build. Now you turn the scale to one stone more, every ounce of which is fat; extra weight to be carried through all the labors of life. If you continue your present dietary and habits, and live five or seven years more, the burden of fat will be doubled; and that insinuating tailor will be still congratulating you. Meantime you are "running the race of life"—a figure of speech less appropriate to you at the present moment than it formerly was—handicapped by a weight which makes active movement difficult, upstair ascents troublesome, respiration thick and panting. Not one man in fifty lives to a good old age in this condition. The typical man of eighty or ninety years, still retaining a respectable amount of energy of body and mind, is lean and spare, and lives on slender rations. Neither your heart nor your lungs can act easily and healthily, being oppressed by the gradually gathering fat around. And this because you continue to eat and drink as you did, or even more luxuriously than you did, when youth and activity disposed of that moiety of food which was consumed over and above what the body required for sustenance. Such is the import of that balance of unexpended aliment which your tailor and your foolish friends admire, and the gradual disappearance of which, should you recover your senses and diminish it, they will still deplore, half frightening you back to your old habits again by saying, "You are growing thin: *what can be the matter with you?*" Insane and mischievous delusion!

It is interesting to observe that the principle I have thus endeavored to illustrate and support, little as it is in accordance with the precept and practice of modern authority, was clearly enunciated so long ago as the sixteenth century. The writings of Luigi Cornaro, who was born of noble family in Venice soon after the middle of the fifteenth century, and was contemporary for seventy years with Titian, wrote his first essay on the subject of regimen and diet for the aged when eighty-three years of age, producing three others during the subsequent twelve years.* His object was to show that, with increasing age and diminished powers, a corresponding decrease in the quantity

* "*Discorsi della Vita Sobria*, del Signor Luigi Cornaro." An English edition, with translation, was published by Benjamin White, at Horace's Head, in Fleet Street, London, 1768. Cornaro's first work was published in Padua in 1558. In his last, a letter written to Barbaro, Patriarch of Aquileia, he gives a description of his health and vigor when ninety-five years old. A paper in the "Spectator" was one of the first notices of him in this country. See vol. iii, No. 195.

of food must be taken in order to preserve health. He died at Padua "without any agony, sitting in an elbow-chair, being above one hundred years old."

Thus he writes:

There are old lovers of feeding who say that it is necessary they should eat and drink a great deal to keep up their natural heat, which is constantly diminishing as they advance in years; and that it is, therefore, their duty to eat heartily, and of such things as please their palate, be they hot, cold, or temperate; and that, were they to lead a sober life, it would be a short one. To this I answer that our kind mother, Nature, in order that old men may live still to a greater age, has contrived matters so that they should be able to subsist on little, as I do, for large quantities of food can not be digested by old and feeble stomachs. . . . By always eating little the stomach, not being much burdened, need not wait long to have an appetite. It is for this reason that dry bread relishes so well with me; and I know it from experience, and can with truth affirm, I find such sweetness in it that I should be afraid of sinning against temperance, were it not for my being convinced of the absolute necessity of eating of it, and that we can not make use of a more natural food. And thou, kind parent Nature, who actest so lovingly by thy aged offspring, in order to prolong his days, hast contrived mattters so in his favor, that he can live upon very little; and, in order to add to the favor, and do him still greater service, hast made him sensible, that as in his youth he used to eat twice a day, when he arrives at old age he ought to divide that food, of which he was accustomed before to make but two meals, into four; because, thus divided, it will be more easily digested; and, as in his youth he made but two collations in the day, he should, in his old age, make four, provided, however, he lessens the quantity as his years increase.

And this is what I do, agreeably to my own experience; and, therefore, my spirits, not oppressed by much food, but barely kept up, are always brisk, especially after eating, so that I am obliged then to sing a song, and afterward to write.

Nor do I ever find myself the worse for writing immediately after meals, nor is my understanding ever clearer, nor am I apt to be drowsy, the food I take being in too small a quantity to send up any fumes to the brain. Oh, how advantageous it is to an old man to eat but little! Accordingly I, who know it, eat but just enough to keep body and soul together.

Cornaro ate of all kinds of food, animal as well as vegetable, but in very small quantity, and he drank moderately of the light wine of his country, diminishing his slender rations as age increased. I am quite aware that I am reciting a story which must be familiar to some of the readers of this review. But it is by no means widely known, and is too apt an example of the value of the law under consideration not to be referred to here.

It must now be clearly understood, as a general rule for men at all ages, that the amount of food ingested ought to accord within certain narrow limits with the amount of force employed for the purposes of daily life. But there is a certain qualification, apparent but not real, of the principle thus enunciated which must be referred to here, in order to prevent misunderstanding or misinterpretation of my mean-

ing in relation to one particular. It is right and fitting that a certain amount of storage material, or balance, should exist as a reserve in the constitution of every healthy man. Every healthy individual, indeed, necessarily possesses a stored amount of force, which will stand him in good stead when a demand arises for prolonged unusual exertion, or when any period of enforced starvation occurs, as during a lingering fever or other exhausting disease. The existence of this natural and healthy amount of reserved force is of course presupposed throughout all my remarks, and its extreme value is taken for granted. That undue amount of stored nutriment, that balance which has been referred to as prejudicial to the individual, is a quantity over and above the natural reserve produced by high health; for, when augmented beyond that point, the material takes the form of diseased deposit, and ceases to be an available source of nutriment. Even the natural amount of store or reserve is prone to exceed the necessary limit in those who are healthy or nearly so. Hence it is that in all systems of training for athletic exploits—which is simply a process of acquiring the highest degree of health and strength attainable, in view of great or prolonged exertion—some loss of weight is almost invariably incurred in developing a perfect condition. In other words, almost any man who sets himself to acquire by every means in his power the best health possible for his system does in the process necessary thereto throw off redundant materials, the presence of which is not consistent with the high standard of function required. Thus what is sometimes called "overtraining" is a condition in which the storage is reduced too much, and some weakening is incurred thereby; while "undertraining" implies that the useless fatty and other matters have not been sufficiently got rid of, so that the athlete is encumbered by unnecessary weight, and is liable to needless embarrassments, telling against his chances in more ways than one. The exact and precise balance between the two conditions is the aim of the judicious trainer.

We are thus led to the next important consideration, namely, that although broad rules or principles of diet may be enunciated as applicable to different classes of people in general, no accurate adaptation to the individual is possible without a knowledge of his daily habits and life, as well as to some extent of his personal peculiarities. No man, for example, can tell another what he can or ought to eat, without knowing what are the habits of life and work—mental and bodily—of the person to be advised. Notwithstanding which, no kind of counsel is more frequently tendered in common conversation by one stranger with another, than that which concerns the choice of food and drink. The adviser feels himself warranted, by the experience that some particular combination of nourishment suits his own stomach, to infer without hesitation that this dish will be therefore acceptable to the stomachs of all his neighbors. Surely the intelli-

gence of such a man is as slender as his audacity and presumption are large. It would not be more preposterous if, having with infinite pains obtained a last representing precisely the size and the peculiarities in form of his own foot, he forthwith solemnly adjured all other persons to adopt boots made upon that model, and on none other! Only it may be assumed that there is probably more difference between stomachs and their needs among different individuals than among the inferior extremities referred to for the purpose of illustration. Thus, in regard of expenditure of food, how great is the difference between that of a man who spends ten or twelve hours of the day at the work of a navvy, as an agricultural laborer in harvest-time, or in draining or trenching land, as a sawyer, a railway porter, or a bricklayer's laborer, or let me add that of an ardent sportsman, as compared with the expenditure of a clerk who is seated at the desk, of individuals engaged in literary and artistic pursuits, demanding a life mostly sedentary and spent in-doors, with no exercise but that which such persons voluntarily take as a homage to hygienic duty, and for a short period borrowed at some cost from engagements which claim most of their time and nearly all their energies! While the manual laborers rarely consume more food than they expend, and are, if not injured by drink, or by undue exposure to the weather, mostly hale and hearty in consequence, the latter are often martyrs to continued minor ailments, which gradually increase, and make work difficult, and life dreary. Few people will believe how easy it is in most instances to meet the difficulty by adopting appropriate food, and that such brain-workers can really enjoy a fair degree of health and comfort by living on light food, which does not require much force to digest, and much muscular activity to assimilate—a diet, moreover, which is important to some of these from another point of view—the financial one—inasmuch as it is at least less costly by one half than the conventional meals which habit or custom prescribes alike to large classes of men in varied conditions of life. But there is another and more important economic gain yet to be named, as realizable through the use of a light and simple dietary. It is manifested by the fact that a greater expenditure of nerve-power is demanded for the digestion of heavy meat meals than for the lighter repasts which are suitable to the sedentary; from which fact it results of course that this precious power is reserved for more useful and more delightful pursuits than that of mere digestion, especially when this is not too well performed.

But those who have little time for exercise, and are compelled to live chiefly within-doors, must endeavor to secure, or should have secured for them as far as possible by employers, by way of compensation, a regular supply of fresh air without draughts, an atmosphere as free from dust and other impurities as can be obtained, with a good supply of light, and some artificial warmth when needed. These ne-

cessities granted, cereal foods, such as well-made bread in variety, and vegetable produce, including fruits, should form a great part of the diet consumed, with a fair addition of eggs and milk if no meat is taken, and little of other animal food than fish. On such a dietary, and without alcoholic stimulants, thousands of such workers as I have briefly indicated may enjoy with very little exercise far better health and more strength than at present they experience on meat and heavy puddings, beer, baker's bread, and cheese. Of course there are workers who belong to neither of the two extreme classes indicated, and whose habits can not be described as sedentary, but who occupy a middle place between the two. For such, some corresponding modification of the dietary is naturally appropriate. But it is a vulgar error to regard meat in any form as necessary to life; if for any it is necessary, it is for the hard-working out-door laborers above referred to, and for these a certain proportion is no doubt desirable. Animal flesh is useful also as a concentrated form of nutriment, valuable for its portability; and, for the small space it occupies in the stomach, unrivaled in certain circumstances. Like every other description of food, it is highly useful in its place, but is by no means necessary for a large proportion of the population. To many it has become partially desirable only by the force of habit, and because their digestive organs have thus been trained to deal with it, and at first resent a change. But, this being gradually made, adaptation takes place, and the individual who has consumed two or three meat meals daily with some little discomfort, chiefly from being often indisposed to make active exertions, becomes, after sufficient time has elapsed, stronger, lighter, and happier, as well as better tempered, and manifestly healthier, on the more delicate dietary sketched. People in general have very inadequate ideas of the great power of habit alone in forming what they believe to be innate personal peculiarities, or in creating conditions which are apparently part of a constitutional necessity, laws of their nature and essential to their existence. Many of these peculiarities are solely due to habit, that is, to long continuance in a routine of action, adopted it may be without motive or design; and people are apt to forget that, if a routine of a precisely opposite character had been adopted, precisely opposite conditions would have been established, and opposite peculiarities would have become dominant, as their contraries are now. Alterations in the dietary, especially of elderly persons, should be made gradually and with caution. This condition fulfilled, a considerable change may be effected with satisfactory results, when circumstances render it necessary. To revert once more to the question of flesh-eating, it should be remarked that it appears to be by no means a natural taste with the young. Few children like that part of the meal which consists of meat, but prefer the pudding, the fruit, the vegetables, if well dressed, which unhappily is not often the case. Many children manifest great repugnance to meat at first, and are coaxed and even

scolded by anxious mothers until the habit of eating it is acquired. Adopting the insular creed, which regards beef and mutton as necessary to health and strength, the mother often suffers from groundless forebodings about the future of a child who rejects flesh, and manifests what is regarded as an unfortunate partiality for bread and butter and pudding. Nevertheless, I am satisfied, if the children followed their own instinct in that matter, the result would be a gain in more ways than one. Certainly, if meat did not appear in the nursery until the children sent for it, it would be rarely seen there, and the young ones would as a rule thrive better on milk and eggs, with the varied produce of the vegetable kingdom.

A brief allusion must be made to the well-known and obvious fact that the surrounding temperature influences the demand for food, which therefore should be determined as regards quantity or kind according to the climate inhabited, or the season of the year as it affects each climate. In hot weather, the dietary should be lighter, in the understood sense of the term, than in cold weather. The sultry period of our summer, although comparatively slight and of short duration, is nevertheless felt by some persons to be extremely oppressive; but this is mainly due to the practice of eating much animal food or fatty matters, conjoined as it often is with the habit of drinking freely of fluids containing a small quantity of alcohol. Living on cereals, vegetables, and fruits, with some proportion of fish, and abstaining from alcoholic drinks, the same person would probably enjoy the high temperature, and be free from the thirst which is the natural result of consuming needlessly substantial and heating food.

There is a very common term, familiar by daily use, conveying unmistakably to every one painful impressions regarding those who manifest the discomforts indicated by it—I mean the term indigestion. The first sign of what is so called may appear even in childhood; not being the consequence of any stomach disorder, but solely of some error in diet, mostly the result of eating too freely of rich compounds in which sugar and fatty matters are largely present. These elements would not be objectionable if they formed part of a regular meal, instead of being consumed as they mostly are between meals, already abounding in every necessary constituent.

Sugar and fat are elements of value in children's food, and naturally form a considerable portion of it, entering largely into the composition of milk, which Nature supplies for the young and growing animal. The indigestion of the child mostly terminates rapidly by ejection of the offending matter. But the indigestion of the adult is less acutely felt and is less readily disposed of. Uneasiness and incapacity for action, persisting for some time after an ordinary meal, indicate that the stomach is acting imperfectly on the materials which have been put into it. These signs manifest themselves frequently, and, if Nature's hints that the food is inappropriate are not taken, they

become more serious. Temporary relief is easily obtained by medicine; but if the unfortunate individual continues to blame his stomach, and not the dietary he selects, the chances are that his troubles will continue, or appear in some other form. At length, if unenlightened on the subject, he becomes "a martyr to indigestion," and resigns himself to the unhappy fate, as he terms it, of "the confirmed dyspeptic."

Such a victim may perhaps be surprised to learn that nine out of ten persons so affected are probably not the subjects of any complaint whatever, and that the stomach at any rate is by no means necessarily faulty in its action—in short, that what is popularly termed "indigestion" is rarely a disease in any sense of the word, but merely the natural result of errors in diet. For most men it is the penalty of conformity to the eating habits of the majority; and a want of disposition or of enterprise to undertake a trial of simpler foods than those around them consume probably determines the continuance of their unhappy troubles. In many instances it must be confessed that the complaint, if so it must be called, results from error, not in the quality of the food taken, but in the quantity. Eating is an agreeable process for most people, and under the influence of very small temptation, or through undue variety furnishing a source of provocation to the palate, a considerable proportion of nutritious material above what is required by the system is apt to be swallowed. Then it is also to be remembered that stomachs which vary greatly in their capacity and power to digest may all nevertheless be equally healthy and competent to exercise every necessary function. In like manner we know that human brains which are equally sound and healthy often differ vastly in power and in activity. Thus a stomach, which would be slandered by a charge of incompetence to perform easily all that it is in duty bound to accomplish, may be completely incapable of digesting a small excess beyond that natural limit. Hence, with such an organ an indigestion is inevitable when this limit is only slightly exceeded. And so when temptations are considerable, and frequently complied with, the disturbance may be, as it is with some, very serious in degree. How very powerful a human stomach may sometimes be, and how large a task in the way of digestion it may sometimes perform without complaint, is known to those who have had the opportunity of observing what certain persons with exceptional power are accustomed to take as food, and do take for a long time apparently with impunity. But these are stomachs endowed with extraordinary energy, and woe be to the individual with a digestive apparatus of moderate power who attempts to emulate the performance of a neighbor at table who perchance may be furnished with such an effective digestive apparatus!

But, after all, let not the weaker man grieve overmuch at the uneven lot which the gods seem to have provided for mortals here below

in regard of this function of digestion. There is a compensation for him which he has not considered, or perhaps even heard of, although he is so moderately endowed with peptic force. A delicate stomach which can just do needful work for the system and no more, by necessity performs the function of a careful door porter at the entrance of the system, and like a jealous guardian inspects with discernment all who aspire to enter the interior, rejecting the unfit and the unbidden, and all the common herd.

On the other hand, a stomach with superfluous power, of whom its master boastfully declaims that it can "digest tenpenny nails," and that he is unaccustomed to consult its likes and its dislikes if it have any, is like a careless hall porter who admits all comers, every pretender, and among the motley visitors many whose presence is damaging to the interior. These powerful feeders after a time suffer from the unexpended surplus, and pay for their hardy temerity in becoming amenable to penalty, often suddenly declared by the onset of some serious attack, demanding complete change in regimen, a condition more or less grave. On the other hand, the owner of the delicate stomach, a man perhaps with a habit of frequently complaining of slight troubles, and always careful, will probably in the race of life, as regards the preceding pilgrim, take the place of the tortoise as against the hare. It is an old proverb that "the creaking wheel lasts longest," and one that is certainly true as regards a not powerful but nevertheless healthy stomach which is carefully treated by its owner; to whom this fact may be acceptable as a small consolation for the possession of a delicate organ.

For it is a kind of stomach which not seldom accompanies a fine organization. The difference is central, not local—a difference in the nervous system chiefly; the impressionable mental structure, the instrument of strong emotions, must necessarily be allied with a stomach to which the supply of nerve-power for digestion is sometimes temporarily deficient and always perhaps capricious. There are more sources than one of compensation to the owner of an active, impressionable brain, with a susceptible stomach possessing only moderate digestive capabilities—sources altogether beyond the imagination of many a coarse feeder and capable digester.

But it is not correct, and it is on all grounds undesirable, to regard the less powerful man as a sufferer from indigestion, that is, as liable to any complaint to be so termed. True indigestion, as a manifestation of a diseased stomach, is comparatively quite rare, and I have not one word to say of it here, which would not be the fitting place if I had. Not one person in a hundred who complains of indigestion has any morbid affection of the organs engaged in assimilating his food. As commonly employed, the word "indigestion" denotes, not a disease, but an admonition. It means that the individual so complaining has not yet found his appropriate diet; that he takes food unsuited for

him, or too much of it. The food may be "wholesome enough in itself," a popular phrase permitted to appear here, first, because it conveys a meaning perceived by every one, although the idea is loosely expressed; but, secondly and chiefly, for the purpose of pointing out the fallacy which underlies it. There is no food "wholesome in itself," and there is no fact which people in general are more slow to comprehend. That food only is wholesome which is so to the individual, and no food can be wholesome to any given number of persons. Milk, for example, may agree admirably with me, and may as certainly invariably provoke an indigestion from my neighbor; and the same may be said of almost every article of our ordinary dietary. The wholesomeness of a food consists solely in its adaptability to the individual, and this relation is governed mainly by the influences of his age, activity, surroundings and temperament or personal peculiarities.

Indigestion, therefore, does not necessarily, or indeed often, require medicine for its removal. Drugs, and especially small portions of alcoholic spirit, are often used for the purpose of stimulating the stomach temporarily to perform a larger share of work than by nature it is qualified to undertake; a course which is disadvantageous for the individual if persisted in. The effect on the stomach is that of the spur on the horse: it accelerates the pace, but "it takes it out" of the animal, and, if the practice is long continued, shortens his natural term of efficiency.

It is an erroneous idea that a simple form of dietary, such as the vegetable kingdom in the largest sense of the term furnishes, in conjunction with a moderate proportion of the most easily digested forms of animal food, may not be appetizing and agreeable to the palate. On the contrary, I am prepared to maintain that it may be easily served in forms highly attractive, not only to the general but to a cultivated taste. A preference for the high flavors and stimulating scents peculiar to the flesh of vertebrate animals mostly subsides after a fair trial of milder foods when supplied in variety. And it is an experience almost universally avowed, that the desire for food is keener, that the satisfaction in gratifying appetite is greater and more enjoyable, on the part of the general light feeder than with the almost exclusively flesh-feeder. For this designation is applicable to almost all those who compose the middle-class population of this country. They consume little bread and few vegetables; all the savory dishes are of flesh, with decoctions of flesh alone for soup. The sweets are compounds of suet, lard, butter, eggs and milk, with very small quantities of flour, rice, arrowroot, etc., which comprise all the vegetable constituents besides some fruit and sugar. Three fourths at least of the nutrient matters consumed are from the animal kingdom. A reversal of the proportions named, that is, a fourth only from the latter source with three fourths of vegetable produce, would furnish greater variety for the table, tend to maintain a cleaner palate, increased zest

for food, a lighter and more active brain, and a better state of health for most people not engaged on the most laborious employments of active life; while even for the last named, with due choice of material, ample sustenance in the proportions named may be supplied. For some inactive, sedentary, and aged persons the small proportion of animal food indicated might be advantageously diminished. I am frequently told by individuals of sixty years and upward that they have no recollection of any previous period since reaching mature age at which they have possessed a keener relish for food than that which they enjoy at least once or twice a day since they have adopted the dietary thus described. Such appetite at all events as has rarely offered itself during years preceding, when the choice of food was conventionally limited to the unvarying progression and array of mutton and beef, in joint, chop, and steak, arriving after a strong meat soup, with a possible interlude of fish, and followed by puddings of which the ingredients are chiefly derived from animal sources. The penetrating odors of meat cookery which announce their presence by escape from the kitchen, and will pervade the air of other rooms in any private house but a large one, and which are encountered in clubs, restaurants, and hotels without stint, alone suffice to blunt the inclination for food of one who, returning from daily occupation, fatigued and fastidious, desires food easy of digestion, attractive in appearance, and unassociated with any element of a repulsive character. The light feeder knows nothing of the annoyances described, finds on his table that which is delightful to a palate sensitive to mild impressions, and indisposed to gross and over-powerful ones. After the meal is over, his wit is fresher, his temper more cheerful, and he takes his easy-chair to enjoy fireside talk, and not to sink into a heavy slumber, which on awakening is but exchanged for a sense of discontent or stupidity.

The doctrine thus briefly and inadequately expounded in this paper may probably encounter some opposition and adverse criticism. I am quite content that this should be so. Every proposal which disturbs the current habits of the time, especially when based on long-prevalent custom, infallibly encounters that fate. But of the general truth, and hence of the ultimate reception of the principles I have endeavored to illustrate, there can not be the faintest doubt. And I know that this result, whenever it may be accomplished, will largely diminish the painful affections which unhappily so often appear during the latter moiety of adult life. And having during the last few years widely inculcated such general dietetic principles and practice, with abundant grounds for my growing conviction of their value, it appears to be a duty to call attention to them somewhat more emphatically than in preceding contributions already referred to. In so doing I have expressly limited myself to statements relating to those simple elementary facts concerning our every-day life which ought to be within the

knowledge of every man, and therefore such as may most fitly be set forth in a publication outside of that field of special and technical record which is devoted to professional observation and experience.—*Nineteenth Century.*

BUILDING AND ORNAMENTAL STONES OF THE UNITED STATES.

By GEORGE P. MERRILL.

WHEN, early in his curatorship in the National Museum, Dr. George W. Hawes, one of the leading American lithologists, assumed charge of that branch of the tenth census relating to the quarrying industry of the United States, it is doubtful if any but himself fully realized the importance of the undertaking aside from its statistical bearings. Dr. Hawes was, however, not a man to be satisfied with figures alone, or one who considered the scope of a census to be merely the compilation of statistics, and in selecting his assistants he did so with especial reference to their qualifications in other lines of work as well. Thus we find upon his list the names of such geologists as Professors Shaler and Wolff, of Harvard; Hitchcock, of Dartmouth; Winchell, of Minneapolis; and others of equal note and ability. These assistants, or special agents as they were called, visited each quarry in person within their respective districts, and, together with collecting the necessary information relative to the amount, kind, and value of stone quarried, number of men employed, etc., made all possible observations in regard to the geological age of the stone, its disposition in the quarry, weathering qualities as displayed in those portions of the outcrop that had been exposed for ages to the action of atmospheric agencies, and, lastly, selected samples of the rock in the form of blocks of sufficient size to dress into four-inch cubes and forwarded them by mail to the National Museum, at Washington, for further examination.* Here a corps of assistants was employed who selected samples for chemical and microscopic analysis, and left the block to be handsomely dressed into a four-inch cube and placed permanently upon exhibition, having meanwhile made careful notes upon its working qualities. Small chips of each rock were ground into films so thin as to be perfectly transparent, and submitted to microscopic examination in order not only to determine what the rock was, but also to ascertain if it contained any mineral constituents liable to unfavorable change on exposure to the weather. Whenever necessary, chemical analysis was resorted to to further aid in the solution of the problems involved.

* These blocks weighed from six to ten pounds each, but, being Government matter, were allowed to pass through the mails, though greatly exceeding in weight the limit set by law.

Unfortunately, Dr. Hawes did not live to carry out the plans he had so carefully laid down, but the vast amount of material he had been instrumental in bringing together remains to-day in the National Museum, a lasting monument to the industry of the man, and probably the most systematic and complete collection of its kind in any museum in the world. As now being arranged in the museum, the collection comprises some four thousand specimens of building and ornamental stone from upward of fifteen hundred quarries in the United States, together with very many from foreign localities.

The importance of such a collection can not be overestimated. Here, within the space of an hour, one can see and examine every variety of stone now quarried, and ascertain its scientific name and chemical or mineral composition, together with the exact locality whence it was derived. That such a reference collection will prove of great advantage to the country at large is evident from the fact that New England granites have been used in nearly every city of importance from Maine to California, sometimes to the almost entire exclusion of equally good material close at hand, but of whose existence or valuable qualities interested parties were ignorant. As an illustration of this, it may be stated that many of the public and private buildings of Cincinnati, Ohio, are built of Eastern granite brought by rail and water a distance of over fifteen hundred miles, while within one tenth that distance lie rocks in every respect equally good for the purpose, and that could be furnished at far less cost! From the published report of the census as it now appears, there were quarried during the year ending May 31, 1880, 115,380,113 cubic feet of building and ornamental stones, valued in the rough at $18,365,055; this being the product of 1,525 quarries representing an invested capital of $25,414,497, and affording employment during the busy season to upward of 40,000 men. The kinds of stone quarried are principally granites, limestones (including dolomite), sandstone, and slates. In value of total product, regardless of kinds, the leading States rank as follows: Ohio, Pennsylvania, Vermont, Massachusetts, Illinois, New York, Maine, and Connecticut, each of these producing upward of $1,000,000 worth of material. Massachusetts and Maine produce the most granite; Ohio, New York, Pennsylvania, and Connecticut the most sandstone; Vermont, Illinois, Ohio, and New York the most limestone, while Pennsylvania leads in the production of slate.

The larger portion of our granites are some shade of gray in color, though pink and red varieties are not uncommon. They vary in texture from very fine and homogeneous to coarsely porphyritic rocks in which the individual grains are an inch or more in length. The largest works at present in operation are at Vinalhaven, Maine. The quarries of the Bodwell Granite Company were first opened here in 1850, and the present annual product is some 217,000 cubic feet, valued at $112,000. The capabilities of these quarries may be best illus-

trated by stating that during a visit to the locality in the summer of 1883 the writer was shown the remains of a huge block of granite three hundred feet long, twenty feet wide, and from six to ten feet thick, that had been blown out from the quarry in a single piece and afterward broken up. The largest single block ever quarried and dressed was the General Wool Monument now in Troy, New York, which measured, when completed, sixty feet in height by five and a half feet square at the base, or only nine feet shorter than the Egyptian Obelisk now in Central Park, New York. The stone is light gray, often slightly pinkish in color, and corresponds closely with that from the now abandoned quarries on Dix Island, whence were taken the granite monoliths, thirty-one feet in height, for the Treasury Building at Washington. Second only to the quarries at Vinalhaven are those at Gloucester, Massachusetts—the quarries of the Cape Ann Granite Company. This rock is coarser in texture than that of Vinalhaven, and often of a slight greenish color. The new Masonic Temple at Philadelphia, and the Butler House, on Capitol Hill, Washington, are good illustrations of the adaptability of this stone for general building purposes.

Closely resembling the Cape Ann granite is that quarried at Quincy in the same State. Quarries were first regularly opened here in 1803, though it was from bowlders of this rock that was built in 1749–'54 King's Chapel, still standing on the corner of School and Tremont Streets, Boston. Quincy granite also was used in the construction of the Bunker Hill Monument, and it was for the transportation of this stone from the quarries to Charlestown that was built the first railway in America. The color of the stone is deep blue gray, and its fitness for interior decorative work is well shown in the granite stairways and polished pilasters of the new City Buildings in Philadelphia.

For columns, house-trimmings, and especially monumental work, the granite from Hallowell, Maine, is used most extensively. This rock is of fine and even grain, and very light gray, almost white in color. Its texture is such that it can be carved very readily, and it has been used in statuary work more than any other of our granites. The statues on the Pilgrim Monument, at Plymouth, Massachusetts, are of this stone. An Italian designer, who served his apprenticeship in Roman studios, is employed by this company, and many of the workmen at the quarries are said to be Italians who worked in marble in Italy, but have learned to cut granite since their arrival at Hallowell.

A granite, closely resembling that of Hallowell, is quarried very extensively near Concord, New Hampshire, and is used for similar purposes. Stones similar to these, but not at present in the market, are found near Frederickton, Virginia, and Atlanta, Georgia.

The red and pink granites now in the market are nearly all from Calais and Jonesboro, in the eastern part of Maine, though others are

quarried at Mount Desert, in the same State; Lyme and Stony Creek, Connecticut; Westerly, Rhode Island; and Graniteville, Missouri. The Calais rock, which is at present the most important of these, is a light pink in color, of medium coarseness of texture, and acquires beautiful surface and polish. It is used extensively for door-posts and the bases of monuments in all our principal cities, competing favorably with the coarser red granite from Peterhead, Scotland, or that from St. George, New Brunswick.

Black granites are quarried in but two, and these widely separated, localities—St. George, Maine, and Penryn, California. Both stones are fine-grained, and nearly black on a polished surface, their dark colors being due to the abundance of black mica and hornblende that they contain. The greater part of the rock quarried and put upon the market under this name is, however, not granite at all, but diabase, a rock differing from granite in containing neither quartz, orthoclase, nor mica, but composed mainly of a triclinic feldspar and augite. The principal quarries of this rock are at Addison, Maine; Medford and Somerville, Massachusetts; York, Pennsylvania; and near Jersey City, New Jersey.

These rocks are all fine-grained and hard, and of a dark-gray color, that from Addison being nearly black when polished. The colors are rather too somber for general building purposes, but, when properly combined with brick or lighter stone, the effect is admirable. The Addison rock is being used to a considerable extent for cemetery and other monumental work, for which it seems peculiarly adapted, and together with the York diabase has been used in the stone-work of the Capitol-grounds at Washington. Diabase from the near vicinity has been used in the construction of the Stevens Institute building at Hoboken, New Jersey, and the court-house and St. Patrick's Cathedral at Jersey City. The fronts of many private and business houses in the last-named city are also of diabase, but the effect is not good, owing to the somber colors already alluded to.

From the fact that Maine and Massachusetts lead in the granite-quarrying industry, it does not necessarily follow that these States produce a greater variety or better quality of material than some others in which the annual product is far less. The supremacy is due rather to natural quarrying and transportation facilities. In Maine especially many of the quarries are situated on hill-sides close by the water's edge, where no artificial drainage is required, and but little carting of the stone is necessary prior to loading it upon vessels, by means of which transportation can be had to all the leading cities of the country without transhipment, an item of no small importance with material so bulky and heavy as stone. Added to this is the fact that the great glacial ice-sheet, that once plowed its way across the whole of New England, has entirely removed the overlying mass of decayed rock and other waste material, and left the fresh granite close to the sur-

face and readily accessible. In regions farther to the south, beyond the limits of glacial action, the granite-beds are still covered with a mass of decomposed rock, often many feet in thickness, and which must be removed before quarrying can commence. It is probably largely due to these facts that the granites of these two States are enabled to compete so favorably in the Washington market with those from near Richmond, Virginia, a distance of only four or five hours' ride by rail.

Granite did not come into general use for building purposes in this country until a comparatively recent date, owing largely to the great difficulty in working it. According to Mr. J. E. Wolff,* one of the earliest stone buildings in Boston was the "stone house of Deacon John Phillips," erected about 1650, and which continued to stand until 1864. It was built chiefly of bowlders from the immediate vicinity. In 1737 was built of bowlders, of Braintree (Quincy) granite, the old Hancock house, since torn down. The granite bowlders scattered over the commons had been very generally used in Quincy for steps, foundations, etc., for some years previous to this, until at last the inhabitants, becoming frightened lest this supply of valuable building material should become entirely exhausted, assembled in town-meeting and voted that "no person shall dig or carry off" any stone "on the said commons or undivided lands upon any account whatever without license from the committee, . . . upon penalty of the forfeiture of ten shillings for every and each cart-load so dug and carried away." Little did they then imagine that, close at their doors, this same stone existed in such quantities that over half a century of almost constant quarrying has failed to exhaust the supply. It was not, however, until the early part of the present century that granite began to be used at all extensively in and about Boston, when the material was introduced in considerable quantities by canal from Chelmsford, thirty miles distant. It was from the Chelmsford stone that was constructed in 1810 the Boston Court-House, in 1814 the New South Church, and in 1818–'19 the first stone block in the city, a portion of which is still standing on Brattle Street. In this year also a considerable quantity of the stone was shipped to Savannah, Georgia, for the construction of a church at that place. The greater part of this granite was, however, obtained from bowlders, and it was not until the opening of quarries at Quincy, in 1825, that the business assumed any great importance. From this time the use of granite for building material increased in a marked degree, and the history of stone-quarrying in Massachusetts may properly begin with this date.

Under the head of marbles are here included all those rocks consisting essentially of carbonate of lime (limestone), or carbonate of lime and magnesia (magnesian limestones and dolomites), which are susceptible of receiving a good polish, and are suitable for orna-

* "Building-Stone and Quarry Industry of the United States," p. 282.

mental work. Vermont is at present the chief marble-producing State of the Union, excelling in this industry all the other States combined, having an invested capital of $3,886,000, and producing annually $1,340,050 worth of material. Of this the larger part is ordinary white, veined, or blue marble from Sutherland Falls, Rutland, East Dorset, and Pittsford. Dark gray, almost black fossiliferous marbles are, however, quarried at Isle La Motte, while red, mottled, and variegated varieties, used for tilings and wainscotings, are found at Mallett's Bay, in the northern part of Lake Champlain. The only statuary marble at present quarried in this country is found at West Rutland and Pittsford, in this State. The rock is of fine and even texture, and without specks or flaws, but differs from its Italian prototype in being of a dead-white color, lacking entirely the peculiar waxy luster so characteristic of the Italian marble. White and bluish marbles are also quarried at Lee, Massachusetts; Sing Sing, Tuckahoe, and Pleasantville, New York; in Montgomery County, Pennsylvania; and in Texas and Cockeysville, Maryland.

The Montgomery County quarries were first opened upward of one hundred years ago, and until as late as 1840 the stone continued to be the general favorite in Philadelphia for all manner of building, although not well suited for the finer grades of ornamental work. Girard College, the United States Custom-House, Mint, and Naval Asylum, are of this stone, while the seemingly endless rows of red-brick houses, with white-marble sills and caps, have come to be as characteristic of Philadelphia as are the brown-stone fronts of New York.

The colored marbles now in the market are brought principally from Tennessee. The ordinary red and white variegated varieties, so commonly seen in table-tops, mantels, soda-fountains, and panelings, are from Rogersville and Knoxville in this State. A fine grade of pink marble is also found at Cleaveland and Knoxville, while a fossil-bearing olive-green variety is brought from Calhoun. A peculiar brecciated stone, which I have not yet seen in the market, is also found here. It consists of yellowish, rounded, and angular fragments of varying sizes, imbedded in a fine, grayish ground-mass. So far as I have yet observed, this stone is entirely distinct from any produced elsewhere. Two fine varieties of gray fossiliferous marbles are produced at Chazy and Plattsburg, in Clinton County, New York, and are known commercially as "Lepanto" and "French gray." The first-named is gray with pink spots, while the last-named is more uniformly gray in color. With the exception of the Tennessee marbles, the Plattsburg stone is more extensively used for furniture and inside decorative work than any other now in the market. The only first-quality black marble now produced in this country is also from New York State quarries at Glens Falls, furnishing a fine grade of this material.

Other than in the States above mentioned no marbles of conse-

quence are now produced east of the Rocky Mountains, though several States are known to contain material that might be thus utilized if put upon the market. California, however, produces two varieties worthy of especial notice. The one is a white, finely crystalline stone, traversed by a network of fine dark lines, in general appearance very much like the celebrated bardiglio marble from the Serravezza quarries, but that the ground-mass is lighter in color. The second variety is the beautiful stalagmite marble, or so-called *onyx*, from quarries at San Luis Obispo. This stone is pearly white in color, translucent, and traversed by fine, wavy, parallel lines, like the lines of growth upon the trunk of a tree. It takes a beautiful polish, and is quite extensively used for small stands and ornaments of various kinds. Excepting in the matter of color it is identical with the celebrated "Oriental alabaster" (wrongly so called), from Blad Recam, near the Ravine of Oned Abdallah, Egypt, this last being of a yellowish or amber hue. The San Luis Obispo rock is the only stalagmite marble of any commercial importance at present found in this country, though a beautiful variety, known as "Mexican onyx," is quarried at Tecali, State of Puebla, Mexico.

In the way of true conglomerate or breccia marble there is at present nothing quarried, though a beautiful variety occurs in inexhaustible quantities near Frederickton, Maryland, and in other parts of this State and Pennsylvania. The stone consists of rounded and angular fragments, of varying colors and all sizes up to several inches in diameter, of quartz and limestone imbedded in a fine gray ground-mass. This admixture of hard and soft material renders the dressing of the stone a matter of great difficulty, since the flinty pebbles break away from the softer ground-mass in the process of cutting. The large pillars of the old House of Representatives in the Capitol at Washington are of this stone.

The rock serpentine, though differing entirely from marble in chemical composition, is used for similar purposes, and may be mentioned here. The three principal sources of this rock, or of serpentine in combination with calcite, are Roxbury, Vermont; Moriah, Essex County, New York; and Dublin, Harford County, Maryland. The Vermont stone is deep green in color, and traversed by white veins of calcite. It takes a beautiful polish, and compares very favorably with the Italian *verde antique* or *verde di Prato* from quarries in Tuscany. The Moriah stone is similar in color, but granular in texture, and spotted, rather than veined. At present it is found in the market in the form of mantels, table-tops, monuments, etc. The Maryland stone is more uniformly green in color than either of those mentioned above, containing very little calcareous matter. It is said to occur in almost inexhaustible quantities and within easy reach of the Baltimore market, but for some unexplained reason little, if any, of it is now in use. A coarse serpentine used for general building

purposes, but unsuited for any kind of ornamental work, is brought in considerable quantities from Chester County, Pennsylvania. The stone is dull-green in color, soft enough to work readily, and is capable of producing most excellent effects, particularly in rock-faced and rubble work. So far as the writer has observed, however, it has not yet been used to advantage, either alone or in combination with other stone, a majority of the buildings thus far constructed of it being not only failures from an architectural stand-point, but showing a remarkable lack of taste in color combination on the part of their designers. A dull-green building with light, yellowish-gray trimmings can scarcely be considered a success artistically, yet this is the style almost universally adopted. The stone has been used quite extensively in and about Philadelphia, and is the one employed in the construction of the buildings of the University of Pennsylvania and Academy of Natural Sciences in that city. It has also been used to some extent in the cities of New York and Washington, though I have not yet observed it elsewhere.

No marbles are at present quarried in this country similar to the white blue-veined Parmazo marble from the Miseglia quarries, like the red-veined from Levanto, like the yellow from Siena, the red "Griotte" from the French Pyrenees, or the black and gold (Portoro Venere) from the Spezia quarries. A stone somewhat resembling this last has been received at the museum from Helena, Montana, but the quarries are not worked, nor is the extent of the deposit known to the writer. A beautiful bright, flesh-pink marble occurs in abundance in Swain and Cherokee Counties, North Carolina, but is not now in the market, owing to lack of transportation facilities.

Of limestones and dolomites, aside from marbles, large quantities are quarried in the States of New York, Pennsylvania, Indiana, Illinois, Iowa, and Missouri. These are mostly of a dull-grayish, uninteresting color, and their uses are chiefly local. The light-colored oölitic limestone of Bedford, Indiana, is, however, an exception to this rule. Not only is the color pleasing and its lasting qualities fair, but its fine even grain and softness render it admirably adapted for carved work. Several of the Southern and Western States have an abundance of limestone and sandstones suitable for general building purposes, but so far as observed few, if any of them, are of such quality as ever to attain anything more than a local market. Kentucky has limestones in abundance and of good quality. Kansas is pre-eminently a State of limestones. These are, however, for the most part soft and porous, of a dull color, and must be found lacking in lasting qualities in other than a very dry climate. A white, chalky limestone is quarried in Trego County, in this State, and is used in the manufacture of whiting. Otherwise than from the product of this quarry, all the other whiting manufactured in the United States is said to be prepared from imported English chalk. Texas furnishes cretaceous limestones of fine and com-

pact texture from the vicinity of Austin. Some of these take a good polish, and might be used as marbles.

No lithographic limestones that can compare with the imported stone have as yet been found in this country. Silverville, Indiana; Glascow Junction, Kentucky; and Saverton, Missouri, each produce fine, even-grained stones of a drab color which have been put upon the market at various times as lithographic stone, but so far as is known to the writer the Missouri stone is the only one now used for this purpose.

The total amount of sandstone quarried in the United States during the census year was 24,776,930 cubic feet, valued at $4,780,391; the same being the product of 502 quarries representing an invested capital of $6,229,600.

Sandstone-quarrying in the United States doubtless began with the itinerant working of the extensive Triassic deposits of "brown-stone" in the vicinity of Portland, Connecticut. Where now are excavations upward of one hundred feet in depth, were then steep cliffs overhanging the river, and from these the inhabitants of Middletown and neighboring localities early began to carry away material for general building purposes as well as for monuments and gravestones. To such an extent had this system of free quarrying been carried, that as early as 1665 a resolve was passed similar in purpose to that relative to the granite bowlders on the Quincy Commons, to the effect "that no one shall dig or raise stone at the Rocks on the east side of the river" (now Portland) "but an inhabitant of the town, and that twelve pence shall be paid to the town for every ton of stone taken." Not long after this the quarries thus opened passed from the possession of the town into that of private parties, and what is now known as Brainard's quarry is said to have been operated since 1700. There are now three quarries situated in a line along the river's bank at this place, from which have been taken altogether some 4,300,000 cubic feet of stone, or enough to build a wall nearly two and a half feet high, and one foot thick, around the entire State!

Of the same geological age and general appearance as those of Connecticut, though varying slightly in color and texture, are the brown and red sandstones quarried in Massachusetts, Pennsylvania, New Jersey, and Maryland. In all of these the cementing material that binds together the rounded and angular grains of which they are composed is largely iron oxide, which gives the color to the stone and yet leaves it soft enough to be worked at only a very moderate cost.

On account of their pleasing colors and easy working qualities these stones have been great favorites for general building purposes, as the monotonous rows of brown-stone fronts in New York city too well attest.

Of about equal importance with these brown Triassic stones are the light-colored subcarboniferous sandstones of Ohio and elsewhere.

These are all fine-grained stones with but little cementing material, the individual grains of which they are composed being held together simply by the cohesion induced by the pressure to which they were subjected at the time of their consolidation. They therefore work very readily, especially when newly quarried, and have been used more extensively for carved work than any other of our sandstones. They are best represented in the market to-day by the so-called Euclid "blue-stones" and Berea "grits" of Ohio, the former being deep blue-gray in color, while the latter is very light. They are well known to the general public in the form of window stools and caps, door posts and steps, for which purpose they have been very extensively used in all our large cities.

Somewhat resembling in general appearance the Euclid blue-stones, but of greater geological age, are the dark, blue-gray compact "gray-wackes," or flag-stones, so extensively quarried in Ulster County, New York, and other parts of this State and Pennsylvania. These stones are of fine and even texture, and split readily from the quarries in slabs, usually but a few inches thick. They are therefore eminently suited for flagging, to which usage they are extensively applied, though they also used for steps and general trimming purposes. The rock quarried at Barryvale, in Sullivan County, is of a similar nature. It was from quarries at this last-named locality that was taken the monster flag-stone, twenty-five feet two inches long, by fifteen feet wide and eight inches thick, that now forms a portion of the sidewalk in front of the Vanderbilt residence on Fifth Avenue, New York. It should be stated, however, that the size of this block was limited only by the means of transportation, and much larger could be obtained at the quarries if desired.

Another very important group of sandstone, but of still greater geological antiquity, belonging to the Medina period of the Upper Silurian formations, is quarried extensively at Albion and Medina, near Rochester, New York. These stones are usually of a reddish color and contain a larger portion of siliceous cementing material than any of those yet mentioned; they are therefore much harder and much less pervious to moisture. The stones are used for all manner of building purposes, flagging, and street-paving. A somewhat similar stone, but of brighter color and Potsdam age, is quarried in the town of Potsdam, in St. Lawrence County, in the same State. This is the stone used in the construction of the Columbia College buildings in New York city.

Sandstones of this nature, i. e., with the larger proportion of siliceous cementing material, are among the most durable of all our building-stones; but their extreme hardness and often poor colors are great drawbacks to their extensive use. In process of dressing such stone an exceedingly fine white dust arises and remains for a long time suspended in the air, to the great inconvenience of the workmen, who tell

marvelous stories of its penetrating powers. They have been known to assert that, if an empty and hermetically sealed glass bottle be placed within the sheds where such stones are being cut, it will shortly be found with a fine white deposit of the dust upon the bottom and *on the inside*, and no argument can convince them that it came there otherwise than through the pores of the seemingly impervious glass!

The quarrying of slate for roofing purposes is an industry of comparatively recent origin in the United States, few of the quarries having been operated for a longer period than twenty or thirty years. The earliest opened and systematically worked are believed to have been those at West Bangor, Pennsylvania, which date back to 1835. The abundance of slate tombstones in many of our old churchyards, however, would seem to prove that for other purposes than roofing these stones have been quarried from a much earlier period. It is stated, moreover, that as early as 1721 a cargo of twenty tons of split slate was brought into Boston from Hangman's Island in Braintree Bay, which may have been used wholly or in part for roofing purposes; but the greater part of the material for this purpose was imported directly from Wales. It is interesting to note, in this connection, that, during the business depression of 1876–'80, almost the entire product of the American quarries was exported to England, where it sold for even less than the Welsh slates, though necessarily at very small profits. The return of more prosperous times, however, created a local demand, and the export trade has been largely decreased accordingly, though considerable quantities are still sent out to the West Indies, South America, England, Germany, and even New Zealand and Australia.

At present not far from $3,328,150 are invested in the slate-quarries of the United States, and the value of the annual product is some $1,529,985.

Pennsylvania is the leading State in this industry, her quarries being located in Lehigh, Northampton, and York Counties, in the eastern part of the State. These slates are all blue-black in color; as are also those from Maine, Massachusetts, and Maryland. The Vermont slates are of a greenish or purple color, while those of New York are mostly purple and red, the latter color being found in extensive deposits near Granville, in Washington County.

Besides for roofing purposes, slates are used for billiard-tables, mantels, floor-tiles, flagging, and in the manufacture of school-slates. For the last-named purpose a soft, even-grained stone is required, and almost the entire supply is at present brought from Pennsylvania and Vermont.

Of late years, the business of marbleizing slates for mantels and fireplaces has become an important industry. All kinds of stones can be imitated by this process, but that most commonly seen is the green verd-antique marble and the variegated marbles of Tennessee. Like

many counterfeits, however, the work is too perfect in execution, and need deceive none but the most inexperienced.

Concerning the future of the building-stone industry little that is definite can be said. As the population increases and becomes more fixed in its abode, there naturally arises a demand for a more durable building material than wood, which is still largely used in the country towns and smaller cities. As wealth accumulates, too, better and more substantial buildings are erected, which are often profusely embellished with the finer grades of ornamental stones. The demand, then, is sure to increase. In regard to the amount of the supply there can be question; everything would seem to depend on the quality, variety, and cost of working of yet-to-be-discovered material. Are we to continue to import as now the finer grades of our ornamental stones, or will our own quarries, yet perhaps to be opened, produce enough and more than enough for our own use? I am inclined to think the latter.

In many of the Eastern and earliest to be settled States very little is yet known regarding their final resources. In Maine, for instance, fully one half of the State is as yet an unknown land. Its present quarries are nearly all immediately upon the coast. What are the resources of its immense interior can not with certainty be foretold. In the Southern and Western States and Territories, this condition of affairs is naturally greatly magnified. The Virginias, North and South Carolina, and Georgia, all contain excellent material, none of which is now in our principal markets. Michigan can furnish brown sandstones in great abundance fully equal to any now quarried in the more Eastern States, and other sandstones of a beautiful mellow tint are known to occur in Western Arizona. The Rocky Mountain region contains an abundance, both in variety and quantity, of granites, sandstones, marbles, and the more recent volcanic rocks, as basalts, rhyolites, and trachytes. Some of these are very beautiful, excelling anything in this respect from the Eastern States. Red granites far excelling the red Scottish granites of Peterhead, or the celebrated Egyptian "Syenite," occur in inexhaustible quantities. We have seen a black-and-white breccia marble from Pitkin, Colorado, which bids fair to be a formidable rival of the imported Portoro marble from the Monte d'Arma quarries, if it occurs in sufficient quantities and is accessible. A fine field for exploration is offered in the extensive stalagmitic deposits on the floors of the numerous caverns so prevalent in many parts of the country. These deposits, as is well known, are identical in composition with the celebrated "onyx" marbles of California, Mexico, and Egypt, already mentioned. The red and purple porphyries so abundant in New Hampshire, Eastern Massachusetts, and other parts of the country, offer an unfailing supply of beautiful and durable ornamental stones, but which are at present kept out of the market, owing to the great cost of working.

This leads us, in conclusion, to an important item in this connection

that must not be overlooked, which is the fact that, with our present high rates of labor in this country, many of our finest grades of ornamental stones can not compete in the market with the imported article, even though greatly exceeding them in point of beauty. In the majority of marbles those lines or spots that give to any stone its peculiar attractiveness are in reality flaws, and hence their presence must add greatly to the cost of working. It is safe to say that the beautiful breccia marble from the French Pyrenees, which has been used for wall-panels in the cash-room of the Treasury Building at Washington, would not be worked to any extent from quarries in this country, so long as the imported article can be obtained at present rates. This fact is rendered probable by the cases of the Maryland breccia and the Vermont verd-antique already mentioned. Neither of these is in the market, simply because the imported marble can be furnished at lower prices. With improved machinery and methods of workmanship there seems, however, no doubt but we may in time compete with foreign cheap labor not only in our own markets, but foreign ones as well.

THE DARWIN MEMORIAL.

THE ADDRESS OF PROFESSOR HUXLEY, AND THE REPLY OF THE PRINCE OF WALES.

IT is not often that the unveiling of a statue is attended with an interest at all comparable with that which characterized this ceremony as performed last Tuesday [June 9th] in the great hall of the Natural History Museum. If the greatness of a man is to be estimated by the measure in which he has influenced the thoughts of men, it is scarcely open to question that the greatest man of our century is Charles Darwin. As Professor Huxley remarked in the course of his singularly judicious and well-balanced address, Mr. Darwin's work has not only reconstructed the science of biology, but has spread with an organizing influence through almost every department of philosophical thought. Yet it was not merely the greatness of the naturalist which invested the proceedings in the Natural History Museum with an interest so unique. It was known to the whole assembly that the man whom they delighted to honor was one whose moral nature had been cast in the same lines of simple grandeur as those which belonged to his intellectual nature. It therefore only needed a passing allusion from Professor Huxley to enable the whole assembly to reflect that it was due as much to massiveness of character as to massiveness of work that within three years of his death Mr. Darwin's name should constitute a new center of gravity in every system of thought. And it was this reflection which gave to the ceremony so unusual a measure of interest. Around the statue were congregated the most representative men

of every branch of culture, from the Prince of Wales and the Archbishop of Canterbury to the opposite extremes of radicalism and free thought. Indeed, it is not too much to say that there can scarcely ever have been an occasion on which so many illustrious men of opposite ways of thinking have met to express a common agreement upon a man to whom they have felt that honor is due. The international memorial could not in any nation have found a more worthy site than the one in which it has been placed ; but, if anything could have added to the "solemn gladness" with which the personal friends of Mr. Darwin witnessed the presentation of this memorial, it must have been the evidence which the assembly yielded that, among the innumerable differences of opinion which it represented, his memory must henceforth be always and universally regarded as a changeless monument of all that is greatest in human nature, as well as of all that is greatest in human achievement.

Concerning the statue itself, we have only to speak in terms of almost unqualified praise. It is, in the truest sense of the phrase, a noble work of art. The attitude is not only easy and dignified, but also natural and characteristic ; the modeling of the head and face is unexceptionable, and the portrait is admirable. The only criticism we have to advance has reference to the hands, which not only do not bear the smallest resemblance to those of Mr. Darwin, but are of a kind which, had they been possessed by him, would have rendered impossible the accomplishment of much of his work. Although this misrepresentation is a matter to be deplored, it is not one for which the artist can be justly held responsible. Never having had the advantage of seeing Mr. Darwin, Mr. Boehm has only to be congratulated upon the wonderful success which has attended his portraiture of the face and figure ; the hands were no doubt supplied by guess-work, and therefore we have only to regret that the guess did not happen to be more fortunate.

The following is the address made by Professor Huxley, in the name of the Darwin Memorial Committee, on handing over the statue to his Royal Highness the Prince of Wales, as representative of the Trustees of the British Museum :

YOUR ROYAL HIGHNESS : It is now three years since the announcement of the death of our famous countryman, CHARLES DARWIN, gave rise to a manifestation of public feeling, not only in these realms, but throughout the civilized world, which, if I mistake not, is without precedent in the modest annals of scientific biography.

The causes of this deep and wide outburst of emotion are not far to seek. We had lost one of those rare ministers and interpreters of Nature whose names mark epochs in the advance of natural knowledge. For, whatever be the ultimate verdict of posterity upon this or that opinion which Mr. Darwin had propounded ; whatever adumbra-

tions or anticipations of his doctrines may be found in the writings of his predecessors; the broad fact remains that since the publication, and by reason of the publication, of the "Origin of Species," the fundamental conceptions and the aims of the students of living Nature have been completely changed. From that work has sprung a great renewal, a true "instauratio magna" of the zoölogical and botanical sciences.

But the impulse thus given to scientific thought rapidly spread beyond the ordinarily recognized limits of biology. Psychology, Ethics, Cosmology were stirred to their foundations, and the "Origin of Species" proved itself to be the fixed point which the general doctrine of evolution needed in order to move the world. "Darwinism," in one form or another, sometimes strangely distorted and mutilated, became an every-day topic of men's speech, the object of an abundance both of vituperation and of praise, more often than of serious study.

It is curious now to remember how largely, at first, the objectors predominated; but, considering the usual fate of new views, it is still more curious to consider for how short a time the phase of vehement opposition lasted. Before twenty years had passed, not only had the importance of Mr. Darwin's work been fully recognized, but the world had discerned the simple, earnest, generous character of the man that shone through every page of his writings.

I imagine that reflections such as these swept through the minds alike of loving friends and of honorable antagonists when Mr. Darwin died; and that they were at one in the desire to honor the memory of the man who, without fear and without reproach, had successfully fought the hardest intellectual battle of these days.

It was in satisfaction of these just and generous impulses that our great naturalist's remains were deposited in Westminster Abbey; and that, immediately afterward, a public meeting, presided over by my lamented predecessor, Mr. Spottiswoode, was held in the rooms of the Royal Society, for the purpose of considering what further steps should be taken toward the same end.

It was resolved to invite subscriptions, with the view of erecting a statue of Mr. Darwin in some suitable locality; and to devote any surplus to the advancement of the biological sciences.

Contributions at once flowed in from Austria, Belgium, Brazil, Denmark, France, Germany, Holland, Italy, Norway, Portugal, Russia, Spain, Sweden, Switzerland, the United States, and the British colonies, no less than from all parts of the three kingdoms; and they came from all classes of the community. To mention one interesting case, Sweden sent in 2,296 subscriptions "from all sorts of people," as the distinguished man of science who transmitted them wrote, "from the bishop to the seamstress, and in sums from five pounds to two pence."

The Executive Committee has thus been enabled to carry out the

objects proposed. A "Darwin Fund" has been created, which is to be held in trust by the Royal Society, and is to be employed in the promotion of biological research.

The execution of the statue was intrusted to Mr. Boehm; and I think that those who had the good fortune to know Mr. Darwin personally will admire the power of artistic divination which has enabled the sculptor to place before us so very characteristic a likeness of one whom he had not seen.

It appeared to the committee that, whether they regarded Mr. Darwin's career or the requirements of a work of art, no site could be so appropriate as this great hall, and they applied to the Trustees of the British Museum for permission to erect it in its present position.

That permission was most cordially granted, and I am desired to tender the best thanks of the committee to the trustees for their willingness to accede to our wishes.

I also beg leave to offer the expression of our gratitude to your Royal Highness for kindly consenting to represent the trustees to-day.

It only remains for me, your Royal Highness, my lords and gentlemen, Trustees of the British Museum, in the name of the Darwin Memorial Committee, to request you to accept this statue of Charles Darwin.

We do not make this request for the mere sake of perpetuating a memory; for, so long as men occupy themselves with the pursuit of truth, the name of Darwin runs no more risk of oblivion than does that of Copernicus or that of Harvey.

Nor, most assuredly, do we ask you to preserve the statue in its cynosural position in this entrance-hall of our National Museum of Natural History as evidence that Mr. Darwin's views have received your official sanction; for Science does not recognize such sanctions, and commits suicide when it adopts a creed.

No; we beg you to cherish this memorial as a symbol by which, as generation after generation of students of Nature enter yonder door, they shall be reminded of the ideal according to which they must shape their lives, if they would turn to the best account the opportunities offered by the great institution under your charge.

The following reply was made by his Royal Highness the Prince of Wales:

Professor Huxley and Gentlemen: I consider it to be a high privilege to have been deputed by the unanimous wish of my colleagues, the Trustees of the British Museum, to accept, in their name, the gift which you have offered us on behalf of the Committee of the Darwin Memorial. The committee and subscribers may rest assured that we have most willingly assigned this honorable place to the statue of the great Englishman who has exerted so vast an influence upon the

progress of those branches of natural knowledge the advancement of which is the object of the vast collections gathered here. It has given me much pleasure to learn that the memorial has received so much support in foreign countries that it may be regarded as cosmopolitan rather than as simply national; while the fact that persons of every condition of life have contributed to it affords remarkable evidence of the popular interest in the discussion of scientific problems. A memorial to which all nations and all classes of society have contributed can not be more fitly lodged than in our Museum, which, though national, is open to all the world, and the resources of which are at the disposal of every student of Nature, whatever his condition or his country, who enters our doors.—*Nature.*

MODERN BRONZES.*

By PERRY F. NURSEY, C. E.

WE had in the earlier ages of mankind a rough and a polished stone age, a bronze age, and an age of iron, each distinguished by the character of the material that was predominantly used by men for their weapons and tools, and have now added to those ages one of steel. In a similar manner we are now entering upon a revival of the bronze age, in which that substance in its varieties is to be put through stages of improvement like those that iron and steel have undergone. Many varieties of bronze have been produced within the last few years that possess features strongly distinguishing them from the ancient alloys, and some very remarkable qualities as compared with them, in view of which they are frequently used in place of even iron and steel, The bronzes of the ancients were composed of copper and tin, as is also what is now regarded as bronze pure and simple, mixed in proportions varying according to the purpose for which the compound is intended. Other substances, however, are often added, without unclassifying the product, which is still called bronze, provided copper and tin are the chief constituents. Among these substances are zinc, lead, phosphorus, manganese, silicium, iron, nickel, arsenic, antimony, and sulphur. It is the addition of certain proportions of one or other of such substances that constitutes the modern development of bronze manufacture, and which has given us some of the most useful and at the same time some of the most remarkable alloys known. These comprise no fewer than eleven distinct products, all of which find their uses in connection with the practice of engineering. They are: phosphor-bronze, silicium-bronze, manganese-bronze, delta-metal, phos-

* From a paper read before the Society of Engineers.

phor-copper, phosphor-manganese bronze, phosphor-lead bronze, phosphor-tin, aluminum-bronze, silveroid, and cobalt-bronze. There are also other bronzes which are used as substitutes for gold in cheap imitation jewelry, but they do not come within the scope of the present paper.

The action of phosphorus on copper alloys is principally due to its reducing qualities, by virtue of which the oxygen absorbed by the molten metal is removed, or the oxides formed thereby are eliminated, and the degree is imparted of homogeneity, strength, and toughness peculiar to the chemically pure metal. The phosphorus, by producing these effects, is converted into a cuprous oxide, which floats on the surface of the molten metal in the shape of a very fluid slag, while the superfluous quantity combines with the metal. It is not, therefore, desirable to add to the bronze a larger quantity of phosphorus than will suffice to reduce the oxide present.

Phosphor-bronze was first prepared by Dr. Kunzel, of Dresden, and was brought into practical use in England early in 1873. The alloys of this class are composed of copper, tin, and phosphorus, and other ingredients in variable proportions, and are made to be either as ductile as copper, as tough as iron, or as hard as steel, according as the proportions of the constituents are varied. The alloys used for rolling and drawing have very different proportions from those employed for castings, bearings, and parts of machinery. The castings of this metal are perfectly sound and homogeneous. Wherever strength, toughness, and durability are desired, phosphor-bronze is found to be better adapted than gun-metal and brass, and in many cases than iron and steel. Having the advantage of not becoming crystalline under the action of repeated shocks and bendings, it is well adapted for making wire-rope, and, not being acted upon by corrosive liquids or the atmosphere, its value as a metal remains constant. The principal varieties of phosphor-bronze, which are produced by slightly varying the proportions of the constituents, are phosphor-bronze duro A, a very dense metal, adapted for bearings carrying heavy wheels running at great velocities, and generally for all quick-speed purposes; and phosphor-bronze duro B, which is intended for the bearings of hot-neck rolls, and for all bearings having to withstand great pressure.

Silicium-bronze was invented by M. Lazare Weiller, of Angoulême, in the search for a material for telegraph-wires, which, together with all the desirable properties of phosphor-bronze, should have a better conducting power. In it phosphorus is replaced by a silicious metalloid, by the incorporation of which a wire is produced offering the same resistance to rupture as phosphor-bronze wire, by the use of which telegraph lines may be furnished with a light, unoxidizable wire, having all needed electrical efficiency. It is also affirmed of wires of this bronze that they are of equal strength with ordinary wires, while not one tenth as heavy; and that, if broken, they will not fall to the

ground as ordinary wires do, but, by virtue of their high elasticity, will spring back and coil up close to the standards.

It has long been known that the hardness of bronze could be increased by adding iron to it, but that quality appears to be acquired at the expense of ductility and toughness, and for that reason, probably, such alloys have never come into general use. Mr. Alexander Parkes, and the late Mr. J. D. Morries Stirling, were probably the first to propose and carry into practice the use of manganese for improving the quality of bronze. Mr. Parkes combined manganese alone with copper, and used this alloy to form improved alloys of brass and yellow metal, of which to make sheathing, rods, wire, nails, and tubes. Mr. Stirling, in 1848, proposed to employ manganese in various brass alloys in which iron was present; and a metal introduced by him was used for some time in railway-carriage bearings. It, however, lacked strength, hardness, and ductility, and has long since been superseded.

A manganese-bronze having all the requisites of a useful alloy was introduced in 1876 by Mr. P. M. Parsons. It is prepared by mixing a small proportion of ferro-manganese with copper, after which various alloys are formed. The ferro-manganese is melted in a separate crucible, and is added to the copper when in a fluid state. The effect of this combination is similar to that produced by the addition of ferro-manganese to the decarburized iron in a Bessemer converter. According to Mr. Parsons, while a part of the manganese cleanses the copper of any oxides it may contain by combining with them and forming a slag, another part, with the iron, becomes permanently combined with the copper, whereby the strength, hardness, and toughness of the compound are modified, according as the proportions of the constituents are varied. Five different qualities of manganese-bronze are made. In the number one quality the zinc alloyed with the copper is considerably in excess of the tin. It may be worked hot or cold, and has great tensile strength and elasticity. Manganese-bronze number two is stronger, and can be cast in sand for special purposes where strength, hardness, and toughness are required; but it has to be melted in crucibles. One of its most important applications is to the production of articles cast in metal molds under pressure; and the articles thus made have the strength, toughness, and hardness of cast-steel, without any of its defects. It is perfectly homogeneous, and, while not possessing a fibrous texture derived from rolling or hammering, is still fibrous in character, in all directions alike, and, when broken, shows a beautiful silky fracture. It can be cast upon any object, on which it will shrink with a force equal to its elastic limit, and, when released, will show an amount of resilience about double that of steel. Its hardness is about equal to that of mild steel.

The number three quality is composed chiefly of copper and tin in about the same proportions as gun-metal, combined with a large percentage of ferro-manganese. Its chief characteristics are great trans-

verse strength, toughness, and hardness, the facility with which it can be cast, and the soundness and uniformity of the castings produced. This quality is used for wheel-gearing, supports and connections of machines, crank-pin brasses, the shells of main and other bearings of engines, axle-boxes, and parts of locomotive-engines. It is also adapted for statuary and for large bells. Its most important application appears to be for making screw-propellers, for which, in its qualities of strength, non-corrosiveness, and perfect trueness in casting, it seems to be superior to any other substance yet found.

The qualities numbers four and five have no particular claim to strength, but are useful for bearings, slide-valves, slide-blocks, piston-rings, and other purposes in which friction has to be taken account of.

Delta-metal, the second and latest example of the successful addition of iron to bronze, was introduced, in 1883, by Mr. Alexander Dick, who named it with the Greek equivalent for the initial of his surname. His preliminary experiments were directed to removing the inequalities in the properties of the iron-bronze alloys previously attempted, and he found that all depended on getting exactly the right proportion of iron and preventing its oxidation during the process of remelting. Delta-metal in color resembles gold alloyed with silver. It can be worked hot and cold. When melted, it runs freely, and the castings produced from it are sound and of a fine, close grain. It can not be welded, but can be brazed, and, when of suitable thickness, "burned." The varieties designed for working hot are capable of being stamped or punched, similar to wrought-iron and steel, into a variety of articles which have hitherto been cast in bronze or brass. This property is of much importance, for the articles thus turned out are cheaper and stronger than brass-castings. The iron introduced into the compound by Mr. Dick's process is really chemically combined; and the alloy does not rust, and has no action on the magnetic needle. Delta-metal may be used to replace the best brass and gun-metal, and in many instances iron and steel also—for parts of rifles, guns, and torpedoes, tools for gunpowder-mills, parts of bicycles, gongs, various domestic articles, spindles for steam- and water-valves, plungers, pump-rods, and boats.

Phosphor-copper is a preparation devised by Mr. W. G. Otto, of Darmstadt, for the purpose of furnishing engineers and founders with a compound, by adding certain proportions of which to a given bulk of metal they can obtain a phosphor-bronze suitable for various purposes.

An article called phosphor-manganese-bronze is in the market, but the manufacturer has not furnished a description of it.

Phosphor-lead bronze, introduced in 1881 by Messrs. K. H. Kuhne & Co., of Löbau, near Dresden, is regarded as specially adapted for all purposes where metal is subjected to constant wear or continuous friction. The introduction of lead into its composition and its homogeneousness are said to give it special properties, by reason of which

the advantages are claimed for it of self-lubrication, greater wearing capacity than any other metal or alloy, coolness under friction, great tensile strength combined with hardness, and non-liability to fracture.

Phosphor-tin is a compound designed to be added to copper for the making of phosphor-bronze.

The history of the practical manufacture of aluminum does not extend very far back into the past; in fact, its commencement dates within the limits of the present generation. The three International Exhibitions which have been held in Paris since aluminum began to be worked on a commercial scale form so many landmarks in its progress. In 1855 it was met with for the first time in the Palais d'Industrie, in the form of a large bar, and was exhibited as silver produced from clay. In the Exposition of 1867 it was to be seen in a more advanced stage, worked up into castings and various kinds of useful and ornamental articles. There also for the first time was seen the alloy aluminum-bronze. The Paris Exhibition of 1878 witnessed the maturity of the aluminum manufacture and its establishment as a current industry, having a regular demand and supply for certain purposes within the limits permitted by its somewhat high price. A little more than two years ago Mr. James Webster perfected his invention for producing aluminum, which is now being practically worked, and gives, it is claimed, alumina without a trace of iron, and free from contamination with other foreign substances. The process is being worked by the Aluminum Crown Metal Company, and the metal itself combines strength and lightness with elegance of appearance and general utility. The bronze is of two kinds—white and yellow—the former being used for cutlery and other table requisites where silver and plated goods are now employed, for metallic fittings, and for every purpose where a non-oxidizing, bright surface, with strength, is desired. The yellow metal is adapted, and is used for articles and for details of machinery where gun-metal and other alloys are now employed. It is said to stand well in engine-bearings, and to give satisfactory results when used in screw-propellers. The bronze is made in five qualities, and each quality is made hard or soft as may be required.

Silveroid, a metal introduced to public notice early in 1884, is an alloy of copper and nickel adjusted with zinc, tin, or lead, in various proportions, according to the purpose for which it is intended; but the secret of success in the manufacture is said to lie in a special method of treatment at a certain point in the process. This alloy is a metal of great whiteness, brilliancy, closeness of grain, and tensile strength.

Cobalt-bronze has been introduced since silveroid, by the same manufacturers, Messrs. Henry Wiggin & Co., who produced that metal. It is whiter and slightly more expensive than silveroid, and is interesting as containing small quantities of cobalt, with the most desirable qualities of that metal, particularly its malleability. It is manu-

factured in several qualities, the higher grades of which are eminently suitable for casting purposes, have a close, steel-like surface, are susceptible of a high polish, are hard and tough, and possess great tensile strength.

MEASURES OF VITAL TENACITY.

By Dr. B. W. RICHARDSON, F. R. S.

IN the observations which I have made on animals passing into death by the lethal process, nothing has impressed me more than the curious differences of vitality or vital values of different animals. The differences are so great they seem almost inexplicable, and in many respects they are so. To some extent, however, they come under law, and we may therefore hope that by carefully continued research what is now difficult and involved may be rendered, in time, simple and perfectly clear.

The first series of observed facts relate to vital differences in animals of different species. In illustration I may take the cat and the dog. Between these animals the distinction of vitality exists irrespectively of age, and of all other conditions and circumstances of which I can gather information.

Of the cat it is commonly said that it has nine lives. By this saying nothing very definite is meant beyond the opinion that under various kinds of death the cat lives much longer than other animals that have to be killed by violent means. When any question is asked of the police or of other persons who have to take the lives of lower animals, they tell you, without exception, according to my experience, that the cat is the most difficult to destroy of all domestic animals, and that it endures accidental blows and falls with an impunity that is quite a distinguishing characteristic.

The general impression conveyed in these views is strictly correct up to a certain and well-marked degree. By the lethal death, the value of the life of the cat is found to be, at the least, three times the worth of the dog. In all the cases I have seen in which the exactest comparisons were made, the cat outlived the dog. A cat and dog of the same ages being placed in a lethal chamber, the cat may, with perfect certainty, be predicted to outlive the dog. The lethal chamber being large enough to hold both the cat and the dog, the vapor inhaled by the animals being the same, with every other condition identical, this result, as an experimental truth, may be accepted without cavil.

The differences, always well marked, are sometimes much longer than would be credible in the absence of the evidence. I have once seen a cat, falling asleep in a lethal chamber in the same period as a dog, remain breathing, literally, nine times longer, for the dog died

within five minutes, and the cat not only continued to breathe, in profoundest sleep, for forty-five minutes, but would have been recoverable by simple removal from the vapor into fresh air if it had been removed while yet one act of breathing continued. This, however, was exceptional, because the cat in the same lethal atmosphere as the dog does not, as a rule, live more than thrice as long ; i. e., if the dog ceases to breathe in four minutes, the cat will cease in from ten to twelve minutes after falling asleep.

The character of the vapor used does not make any difference, relatively. Carbonic oxide, carbonic acid, chloroform-vapor, carbon-bisulphide vapor, yield the same relative results. Pure carbonic oxide kills with intense rapidity, but it kills the cat less quickly than the dog. If instead of a lethal vapor prussic acid be used, in administration by the mouth, the cat dies more slowly than the dog. The same is true in respect to death by drowning.

Still more curiously, recovery from apparent death is much more frequent in the cat than in other domestic animals. Mr. Warrington once observed a cat recover from apparent absolute death by prussic acid, eight hours after it had lain as if dead. I once saw a young cat come back to life after two hours of immersion under cold water.

I do not know many facts bearing on tenacity of life in other animals, but I have observed that sheep in a lethal atmosphere die very rapidly, goats much less rapidly, and pigeons more rapidly than common fowls. There is, apparently, a specific tenacity in all species.

In animals of the same species there are distinctions determinable by peculiarities in the animal itself. In one instance where a large number of dogs were put to sleep in the lethal chamber, one was found in deepest sleep, but still breathing, side by side and partly covered by another that was not only dead but cold and rigid. A similar fact occurred last year in the human subject in a mine. A father and son killed by fire-damp lay together, the father dead, the son living, though he, the son, had come first under the influence of the lethal gas. In all the fatal accidents to the human subject from the administration of chloroform or other narcotic vapor we see the same illustration. I doubt whether in any one of these unhappy events the death has been induced by what would be, under the common run of administrations, a fatal dose. But some die from a dose that would not so much as narcotize others. An analogous series of facts is met with in relation to the effects of physical and mental shocks and to surgical operations.

The variation of measure of tenacity of life is unquestionable. What is the reason of it? What is there in one species of animal that gives a measure of tenacity over another? Why, for instance, is the cat more tenacious of life than the dog?

The only answer as yet is, that the cat is endowed with more vitality. But this is no answer as to details. Is the endowment of the

greater vitality centered in the nervous system, in the muscular, in the respiratory, in the blood, in the membranes?

And wherever centered, what is the endowment?

The difference of tenacity in animals of the same species is more approachable, because we know certain factors that afford an explanation of it.

Age is a factor. In the young the tenacity is more distinctly marked than in the old. In a broad sense there is no exception to this rule.

Degenerations of tissues are factors. Fatty degenerations are reducers of tenacity. Lessened arterial tension is a reducer.

Race or breed is another factor. The strong, wiry, muscular animal of any species is more tenacious of life than the heavier and less elastic. The terrier outlives the spaniel or retriever. The man of sanguine temperament outlives the nervous and lymphatic man.

In the operation of tracheotomy for croup or diphtheria in children, other things being equal, the chances of a successful issue will be as two to one to a spare, active, wiry subject compared with the chances of the full-cheeked, full-bodied child with luscious lips and rich flowing curls of pale or golden hue. The first of these will live almost through the gate of death; the second will succumb without a struggle for life.

Will is a factor. I have twice seen tenacity of life maintained, as it were, against all possibilities by what is called the will of the sufferer. Mr. F. Hall, of Jermyn Street, had a patient in the last stage of pulmonary consumption, whom I had seen with him in what appeared to be a condition of emaciation and exhaustion that precluded the feeblest effort toward rising from bed. Yet one day, and three weeks only before actual death, this sick man by a supreme effort of volition rose, dressed himself, went out of his house, and had to be sought for by his friends and brought back, with gentle compulsion, simply to die.

A young authoress of great promise, suffering from the same disease—pulmonary consumption—in the very last days of her life rose from bed, and in the most vigorous style was engaged for several hours in composition on letters and work which had been for months laid aside. Her friends, bewildered by the phenomenon, could scarcely accredit that the effort did not presage recovery, until rapid collapse dispelled the illusion.

This tenacity of life illustrated through volition is the equivalent of that courageous endurance which some in famine and war have "miraculously" exhibited.

These examples illustrate the influence of certain factors on tenacity of life, and they may, one day, lead up to the prime cause of the difference of tenacity if they and other facts bearing on the matter be carefully observed and recorded. But, as yet, the prime cause remains a troubled and troublous question.—*The Asclepiad.*

CURIOSITIES OF TIME-RECKONING.

By M. L. BARRE.

THE natural unities for the measurement of time are three, and are afforded by the rotation of the earth upon its axis, the revolution of the moon around the earth, and the revolution of the earth around the sun; of which the mean values respectively are 24 hours; 29 days, 12 hours, 44 minutes, 2·9 seconds; and 365·2422 days. These numbers are incommensurable and wholly independent of one another. But men have tried to connect them from the most remote ages, and have devised the lunar-solar year, the duration of which is related to the movements of the sun and the moon. Although this system may appear complicated, it is in reality quite simple, for the sun and moon spare man the trouble of calculating the days, while the years and months write themselves in large characters in the appearance of the sky and of vegetation.

The lunar-solar year thus having its origin in Nature, is found in the most ancient form of the Jewish calendar. The Israelite year was so regulated that the feast of the Passover was celebrated on the fourteenth day of the first month, when the barley to be offered in sacrifice was ripe at the full moon. This marked the first month of the year, named Nisan, and served as the point of departure for the twelve usual months. But, if the ripening of the barley did not occur during the fortnight following the end of the year, another month was intercalated, and the new year began with the next new moon. If we desire an exact and rigorous measure, this form of year is simply confusing. The Jews have years of twelve lunar months, of twenty-nine or thirty days, to which is added a thirteenth month, when the year is embolismic; and they might contain 353, 354, 355, 383, 384, or 385 days. The Jewish calendar also included a period of nineteen solar years, or a lunar cycle of 235 months. The years date from the creation of the world, which is fixed by the Jews at October 7th, B. C. 3761.

The Chinese month begins with the new moon; the first month when the sun enters Pisces, the second when it enters Aries, etc. But if the sun does not enter a new sign of the zodiac with the new month, an additional month is introduced, which is given the same name as the preceding one, with a distinctive sign. The months are of twenty-nine and thirty days, but there is no absolute rule for their succession, nor for the place of the supplementary month, nor for the intercalation of complementary years; and, as the beginnings of the months and the years are calculated from the movements of the celestial bodies, the whole year is uncertain and changeable. In the difficulty of ascertaining from what tables the ancient Chinese calculated their astronomical elements, there would be great uncertainty in com-

paring a Chinese date with the corresponding date of any other chronology, were it not that the learned from the most ancient times have used a cycle of sixty days in much the same manner as we use our week of seven days, without regard to the movements of the sun and the moon. This calendar has become of prime necessity for fixing the year in which a particular day may have fallen; and the preparation of it is considered a matter of such importance that it is confided to an imperial mathematical tribunal, and, when the work is completed, it is ceremoniously presented to the members of the imperial family and the chief personages of the government.

The Chinese years are designated by two numbers. The first, the official number, indicates the number of the years of the reign of the emperor, and is variable; the second pertains to a cycle of sixty years, of which each year has a special name. In all Eastern Asia, the system employed for the designation of the years is based upon the combination of the name of ten, *kan*, with one of the denominations of twelve, *chi*. The cycle formed by a combination of this character may be found in Japan, Manchooria, Mongolia, and Thibet. The Aztec cycle of fifty-two years, formed of two smaller cycles of four and thirteen years, led Humboldt to suggest that Asiatic ideas might have penetrated to Mexico. Sometimes, but rarely, the Asiatics count by cycles of twelve years, each of which has the name of an animal.

The lunar-solar year of the Hindoos was based on a sidereal solar year of which the twelve months, of unequal length, had a duration exactly defined. The solar month Chaîtra consisted of 30 days, 20 hours, 21 minutes, 2 seconds, and 36 thirds, the day being divided into sixty hours. The year began with the new moon preceding the beginning of the solar year. When two lunar months began within the same solar month, the first one was intercalated. If no lunar month began in the course of a particular solar month, the year lost an ordinary month, but two intermediate months were added. Every Hindoo month has a particular name, and the new moons, which serve to fix the beginnings of the months and the years, are calculated with so great precision that it is much more easy to identify an ancient date in India than in China. But some difficulties arise out of the use of different systems in ancient times, and also from the fact that the Hindoo day is the thirtieth part of the lunar month, which consists of twenty-nine days and a half, and is consequently shorter than the natural day.

The computation of the years begins with zero, the first year counting as 0, the second as 1, and so on. Each year bears a particular name appertaining to a cycle of sixty years, which is, however, different from the Chinese cycle, and is based on the course of the planet Jupiter, which performs its revolution in 11·86 years, or, in round numbers, twelve years. The Hindoo cycle is therefore equivalent to five Jovian revolutions and $\frac{1}{10}$ of a year (11·86 years $\times$ 5 = 59·30 years); in three

periods of sixty years we have to omit two years, one in the first cycle, and the other in the third; but in thirty cycles we have to omit 0·7 year × 30 = 21 years, while the preceding correction has omitted only twenty years; so a new suppression of a year has to be performed in each series of thirty cycles.

The Hindoos also employed ages in the computation of time, and these, too, divided into periods of different durations. The present age is the *kali yuga*, or the age of iron; 4,985 years of it have already passed, but its total duration is supposed to be 432,000 years. The succession of the ages, counting back, is given as follows:

Fourth age—*Kali yuga*, age of iron, or of woe (the present age), to be of 432,000 years.

Third age—*Dvapara yuga*, 864,000 years.

Second age—*Treta yuga*, or age of silver, 1,296,000 years.

First age—*Krita yuga*, age of gold, or of innocence, 1,728,000 years.

These four ages form the *maha yuga*, or great age, of 4,320,000 years. The length of a patriarchate is seventy-one maha yugas, or 306,720,000 years, to which is added a twilight period of 1,728,000 years, making in all 308,448,000 years. Fourteen of these patriarchates, augmented by a dawn of 1,728,000 years, gives 4,320,000,000 years, which form a *kalpa*, or the *æon* of the Hindoo chronology.

A kalpa is only a day in the life of Brahma, whose nights are also of the same duration. Now, Brahma lives a hundred years of three hundred and sixty days and three hundred and sixty nights. The present epoch is the *kali yuga* of the twenty-seventh grand age of the seventh patriarchate of the first æon of the second half of the life of Brahma, who is now in his 155,521,972,848,985th spring. Yet the whole life of Brahma is only a little longer than a single wink of Siva's eye!

The Greeks employed first two years of 12 months each consisting of 30 days, and a third year of 13 months, giving an average of 370 days to the year; then the cycle of 19 lunar years, with seven months intercalated in each cycle to obtain 19 solar years. The months were of 29 and 30 days, and the time was calculated by Olympiads, of four years each. Afterward, Calippus introduced the cycle of Méton, 433 years B. C., shorter than the 19 solar years, in consequence of the suppression of a day every 76 years. The era of the Olympiads goes back to B. C. 776, at which time Corœbus obtained the prize in the race, from and after which date the names of the victors were inscribed on the official registers.

The ancient Egyptians reckoned at first 12 months of 30 days, or 360 days; but they afterward added five supplementary days. The years were counted from the accession of the kings; and the canon of Ptolemy is a chronological table giving the changes of the reigns. The same form of year was formerly in use among the Persians, with the difference that they added the five supplementary days to the eighth month instead of to the twelfth. Their months had particular

names, and their years were counted from the accession of Yesdegerd I, A. D. 399; an epoch which is still employed by the Persians in some parts of India. Five thousand years ago, the heliacal rising of Sirius announced to the Egyptians an event of prime importance to them—the overflow of the Nile. They honored the watchful constellation that includes this star with the name of "The Dog," and worshiped it under the title of Anubis. Their year consisting of 365 days, they remarked that the phenomenon took place later, at the rate of a day every four years, so that after 1,461 years of 365 days (or 1,460 years of 365¼ days) the heliacal risings took place in the original order, after having successively occurred at very different days and hours. This period of 1,461 Egyptian years was called the Sothic period, or the period of the dog. After B. C. 25, the Egyptian year contained 365¼ days, or nearly the real value of the year. This was called the Alexandrian year. The Copts still employ it, but begin their reckoning from Martyr's day in the reign of Diocletian, August 29th, A. D. 284, while the Alexandrian era began with the battle of Actium, September 2d, B. C. 31. Three Egyptian years included 12 months of 30 days each followed by five epagomenous days; while the fourth or following year had a sixth epagomenous day.

The Roman year consisted of 304 days under Romulus, 355 under Numa, and 366 on the intercalation of the month *Mercedonius*. The irregularities of their calendar were so great that the *pontifices* were charged with the duty of regulating the number of days in the intercalated month. Unfortunately, some of the less scrupulous of these functionaries fell into a way of "doctoring" the year so as to make it longer when their friends, or shorter when their enemies, were in office! The corruption was carried out so recklessly that the feast of the *Autumnalia* was made to come in the spring, and the festival of Ceres, the goddess of the harvest, was celebrated in the middle of the winter! Julius Cæsar put an end to this disorder by introducing the year of 365¼ days, and gave to the months such numbers of days as made the intercalation of the epagomens unnecessary. The 366th day of the fourth year was added to the month of February, which then had 29 days, and as this caused the sixth day of the kalends to be counted twice (*bis sexto calendarum*), the name of *bissextile* was given to this year. This reform took place in the year 708 of Rome (46 B. C.), which year Julius Cæsar ordered to consist of 445 days, so as to make the civil year and the tropical year agree. Hence that year was called the year of confusion. Cæsar's calendar is the basis of the calendar which, further corrected by Pope Gregory XIII, is now in use among the Western nations.

The Mexican year was a peculiar form of the year of 365¼ days. It included 18 months of 20 days each, to which were added five supplementary days; and, after 52 years, 13 new days made up out of the neglected quarters of days.

The ancient Irish year was curiously formed. The unit being the week of seven days, they computed 12 months of 30 days each, to which they added four supplementary days to give an even number of weeks, and then every six or seven years they added a week, so that the years might be of 52 or 53 weeks.

The last essay in reforming the calendar was made during the French Revolution, partly with the object of introducing the decimal system into the calculation of time, and partly to eliminate everything relating to the Roman Catholic or any other religion. The months, of thirty days each, were given names, generally typical of some peculiar feature characterizing them. They were divided into three periods of ten days, or decades, to take the place of the weeks, with six intercalated days (five in leap-years) at the end of the last month. The intercalation was not periodic, but was based on exact astronomical calculations. This calendar was used for thirteen years, beginning with the proclamation of the republic, on the 22d of September, 1792.

In the lunar year, the months are alternately of 29 and of 30 days, the moon's synodical revolution taking place in about 29½ days. The lunar cycle of the Mohammedans comprises a period of thirty lunar years, during which the seasons begin at all times of the year. If a Turkish festival now falls in the middle of the winter, it will, fifteen years hence, be celebrated in the summer.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF M. CHEVREUL.

"PERHAPS never in the history of science," said the London "Lancet" a year and a half ago,* "has a distinguished career equaled in its length that of M. Chevreul; . . . and it is probably altogether unique for a *savant* to be able, at one of the most distinguished scientific societies in the world, to refer to remarks which he made before the same society more than seventy years previously." The allusion is to a reference with which the veteran chemist had supplemented a communication he had read a few days before to the French Academy of Sciences: "Moreover, gentlemen, the observation is not a new one to me. I had the honor to mention it here, at the meeting of the Academy of Sciences, on the 10th of May, 1812." When asked in 1883 if he had seen a certain piece at one of the theatres, he answered, "No, I have not been inside the doors of a theatre since Talma's death—in 1824," or fifty-nine years previously. Talking of the weather during a mild period in the winter of 1883, he said, "The severest winter I ever experienced was that of 1793," indicating the recollection of a fact ninety years old. M. Chevreul appears to have come from a long-lived

* December 24, 1883.

ancestry. His father, Michel Chevreul, a distinguished physician of his day, according to Larousse's "Cyclopædia" (born 1754, died 1845), was ninety-one years old at the time of his death; while the "Lancet" finds somewhere nineteen additional years, and makes his age a hundred and ten years. If discrepancies like this can occur in writing exact biographies of our own times, why should we be surprised at the variances in the legends of ancient days?

Michel Eugène Chevreul was born at Angers, France, where his father was hospital physician and a professor in the Obstetrical School, on the 31st of August, 1786. He studied the course of the Central School of his native city, and then, when seventeen years old, went to Paris, where he became associated with Vauquelin in the manufacture of chemicals, and was made director of his laboratory. He was afterward, in 1810, selected by Vauquelin as preparator in the course of Applied Chemistry at the Museum of Natural History. In 1813 he was given the title of Officer of the University, and was placed in the chair of Chemistry of the Lycée Charlemagne. In 1824 he was made special Professor of Chemistry at the Gobelins factory, and director of the dye-houses connected with that establishment. In 1826 he was admitted to the Academy of Sciences, in the place of M. Proust, in whose favor he had retired from the candidacy in 1816, when he had had an opportunity of being elected. In 1830 he succeeded his former master, Vauquelin, in the chair of Applied Chemistry in the Museum of Natural History. He has been charged with the administration of the Jardin des Plantes, where he has had occasion to defend the ancient prerogatives of the body he represented against the encroachments of the political administration, and where he made a formal protest during the siege of Paris against the barbarous bombardment of the buildings of the institution.

The enumeration of the discoveries that science owes to M. Chevreul would far pass the limits which it is possible to assign to this sketch. The most important of them have been perhaps in the fields of researches on fatty bodies of animal origin, and of colors, their contrasts, their harmonies, and the graduation of their shades. The "Recherches chimiques sur les corps gras d'origine animal" ("Chemical Researches on Fatty Bodies of Animal Origin"), on which the foundation of his reputation was laid, appeared in 1823. In this work the author developed his new ideas on the relations of fatty bodies and the ethers, and propounded the first exact theory of saponification, whether produced by acids or by bases, by showing that either of those two classes of bodies tend to speed the decomposition of fat-substances in acids and in glycerine, through the absorption of a certain number of equivalents of water. The same decomposition takes place spontaneously but slowly in the open air, and is the cause of the rancidity of fats. The water absorbed in the course of the transformation contributes to the formation of the resultant fat-acid, and the glycerine is separated. When a

fatty substance is submitted to the action of a strong acid, the decomposition takes place instantaneously, because the acid separates the glycerine and unites with it. If, on the other hand, the action is accomplished by means of an energetic base, the base determines the formation of a fat-acid, and combines with it, so as to leave the glycerine isolated. Glycerine had been discovered by Scheele in 1775, but, until M. Chevreul's experiments, was regarded as only accidentally present in some fats; and to M. Chevreul is due the discovery that it is always separated in the saponification of fats, and that those bodies are now regarded as salts, formed of glycerine as a base, combined with some acid. This theory led up to the invention of star-candles, a boon to mankind, of the value of which the present generation, with its gas-lights and petroleum-lamps, can have no conception. For this discovery M. Chevreul was awarded the grand prize of twelve thousand francs founded by the Marquis d'Argenteuil, in conferring which the Société d'Encouragement pour l'Industrie Nationale declared with justice that it was only registering the opinion of all Europe concerning researches which might serve as models to all chemists. M. Chevreul, it may be added, never thought of turning his discoveries to his personal profit, but gave them freely to the world, and was satisfied with being a student of science.

M. Chevreul's researches in coloring-matters at the Gobelins factory and at the Museum gave occasion to the publication of "Leçons de chimie appliquée à la teinture" ("Lessons on the Application of Chemistry to Dyeing," 1828–1831); of a memoir on the law of the simultaneous contrast of colors, and on the arrangement of colored objects according to that law in its relations to painting ("Sur la loi du contraste simultane des couleurs et sur l'assortiment des objets colorées, considéré d'après cette loi dans ses rapports avec la peinture," 1829), and of a memoir on colors and their application in the industrial arts ("Des couleurs et de leur application aux arts industriels à l'aide des cercles chromatiques," 1864); works embodying novel ideas, the application of which in manufactories and workshops has been attended with important results. M. Chevreul was much grieved when, in his advanced age, the management of the Gobelins factory placed him on the retired list; but, in order to appease his feelings, he was allowed to retain his appointment with the full salary attached to it. In 1879 he was retired from the directory of the Museum, but was permitted to retain his chair as professor.

Among the honors that have been accorded to him are membership of the Royal Society; President of the Agricultural Society; Commander, Grand Officer, and Grand Cross of the Legion of Honor; and other memberships and decorations at home and abroad. He was a member of the International Juries at the Expositions of London and Paris. In September, 1872, the French Academy of Sciences presented him with a medal in anticipatory commemoration of the fiftieth

year of his membership. The fiftieth year would not strictly have occurred till 1876; but it was generally understood that he would have been elected in 1816, had he not urged the Academy to give the vacant place to M. Proust, who was old and infirm, and could not afford to wait. M. Dumas, the Permanent Secretary of the Academy, in a "gracefully-worded speech," recounted the many valuable services rendered by M. Chevreul, "the dean of French students," as he was modestly accustomed to style himself, and at the same time bore warm testimony to the personal character of the man. M. Élie de Beaumont, who had been a pupil of M. Chevreul, added a few words of veneration and respect for his old master, after which the latter, attempting to respond, could only express his inability to do so. In 1873 the Albert gold medal was awarded him by the English Society of Arts, for his valuable researches in connection with saponification, dyeing, agriculture, and natural history. In November, 1876, he was entertained at dinner by eighty *savants* in celebration of the fiftieth anniversary of his professorship and membership of the Academy of Sciences. The American Association for the Advancement of Science, at its Boston meeting in 1880, sent him a congratulatory telegram on his reaching his ninety-fifth year, and expressed the hope that he might be spared to continue his labors until the end of his century, which only a few months are lacking to see fulfilled. In the same year, he completed the fiftieth course of his lectures at the Museum, on the application of chemistry to organized bodies. Each course consisted of forty lectures, so that the fifty courses included in all two thousand lectures.

According to "Nature," M. Chevreul's first important work was published in 1806. Among his other works than those we have already named, are one on organic analysis and its applications (1824); "Théorie des effets optiques que présentent les étoffes de soie" ("Theory of the Optical Effects presented by Silken Cloths," 1848); "De la baguette divinatoire, du pendule, et des tables tournantes" ("Of the Divining-Rod, the Pendulum, and Turning-Tables," 1854); "The History of Chemical Science," of which the first volume was published in 1866; "Memoirs of the Academy," completed in 1872, "a most interesting work, which throws light on many of the most scientific questions of the day"; and numerous papers, articles in encyclopædias, and books of less general interest than those mentioned. A curious illustration of his vigor and activity, lasting into extreme old age, is afforded by a communication which he made to the Academy of Sciences on the 4th of February, 1884, which was on the varying color-effects produced by the glare of a conflagration playing upon a gas-light that stood in front of the Museum, which he observed for an hour. Delicate work that for the eyes of a man ninety-eight years old! That vigor still continued till the beginning of the present year, when M. Chevreul presided at the meeting of the new

Association of French Students, the "Scientia"; and when his name was mentioned in connection with those of Jamin, Pasteur, De Lesseps, and Léon Say, as one of the persons whose co-operation was expected to insure the success of the organization. In his address at this meeting, he declared himself still a student.

On the 4th of January last the students of Paris made a manifestation before M. Chevreul's house, with their flags flying, in honor—anticipating the day by a few months—of the one hundredth anniversary of his birth. Twenty delegates from the body were received in person by M. Chevreul, when M. Delcambre, President of the Association of Students, spoke in eulogy of the great *savant* by whom France is honored, and who, reaching his hundredth year, still remained robust and valiant, and preserved all the force of his genius and his old energy in work. In concluding his address, M. Delcambre said: "Illustrious and beloved master, the students of all the schools have joined in this manifestation because you are to us all—I say it with full assurance—a dean, and, I hope I may be permitted to add, a comrade. As a *savant*, you have contributed to the progress of humanity; as a Frenchman, you have added to the grandeur of France. The students by my lips transmit to you their good wishes and felicitations." M. Chevreul appeared much touched by this demonstration, and thanked the students with a voice marked by emotion. M. Delcambre then presented him a register containing the signatures of all the participants.

An interesting account of M. Chevreul's habits is given by a writer who is quoted in the "Lancet": "He is generally lightly clad, and wears no hat unless under circumstances in which he is obliged to appear in one; indeed, he hardly needs a hat, as he has most luxuriant hair. He is constantly at work, allowing only ten minutes for each of his meals, of which he has but two a day. He breakfasts at seven, the repast consisting of a plate of meat and another of vegetables, which he eats together, the whole being washed down with two tumblers of water. He is said to have never drunk a glass of wine in his life. He dines at seven in the evening, and takes nothing between the two meals except a small loaf at noon, which he eats standing and by the side of his alembics. The writer who relates this states that on a visit to M. Chevreul he found him in the attitude just described, and on expressing his surprise at the frugal manner in which he lived, M. Chevreul observed, 'I am very old' (this was in 1874), 'and I have yet a great deal to do, so I do not wish to lose my time in eating.'" In his work he is said to follow a motto that he has chosen from a maxim by Malebranche, and which is regarded by "Nature" as affording a true key to his life, his works, and his discoveries: "Chercher toujours l'infaillibilité, sans avoir prétention de l'atteindre jamais" ("Always to seek infallibility, without having the pretension of ever reaching it").

EDITOR'S TABLE.

THE NEW TYNDALL SCHOLARSHIPS.

THERE are multitudes who still remember, with vivid pleasure, the brilliant course of scientific lectures delivered in 1872, in several of our chief cities, by Professor John Tyndall, of the Royal Institution of Great Britain. They made a strong impression at the time, and impelled many young persons to give greater prominence to science in their studies. But there was another and a more special influence exerted by these lectures in accordance with the deeper purpose of Professor Tyndall. The public mind was favorably affected by them in regard to the claims of pure or theoretic science. We plume ourselves on being very practical in this country, and by "practical" we generally mean the opposite of theoretical—that which issues in tangible and immediate use. Professor Tyndall showed that this is a mistaken view. He was not complaisant toward the lower motives from which science is so generally pursued; and insisted strongly upon the more elevated considerations by which the students of science should be animated. He enforced, with much impressiveness, the important lesson that to yield its noblest results science must be studied for the simple love of truth and the extension of our knowledge of Nature, leaving its utilitarian benefits to follow as they always will when new light has been thrown upon any important group of phenomena. The unselfish pursuit of science for these nobler ends was urged by Professor Tyndall upon our young men with great earnestness and something of the inspiration of religious conviction; yet none realized at the time how firm and far-reaching was his purpose, nor how lasting was to be the influence of his work in this direction in this country.

When Professor Tyndall was solicited to come to America, and told what a golden harvest he could reap by lecturing here, he invariably replied that no consideration of the kind would have any weight in inducing him to accept the invitation. "*If* I come to you," he would say, "it must be because my friends in the United States desire it, and think that I could be of service in the cause of American science; but I will not lecture for the sake of money, nor would I bring away a dollar of the proceeds of my labor." And when the lectures closed, true to his purpose, he left all of the money he had earned, above expenses incurred, for the promotion of scientific education among American youth. But this was not all: he devoted the money to the advancement of the distinctive ideas which he had illustrated in his lectures, by appropriating it to the assistance of such young men as desire to devote themselves to original scientific study and research. He left it in care of three trustees, the income to be expended in aid of American students of tested ability, who might wish to avail themselves of the higher opportunities of scientific culture available in the European universities.

But there were difficulties attending the carrying out of this plan which prevented the full realization of its advantages. Several students were aided, and with great satisfaction; but it was not so easy to find the young men who had the proper qualifications to be entitled to the benefits of the trust. There were, of course, plenty of them, but the finding them out was more of a task than had been anticipated. The trustees were scattered, and were busy men, having little time for correspondence, while the employment of a paid secre-

tary was impracticable. As a consequence, the income accrued faster than it was consumed, and, as the money had been fortunately invested, it at length accumulated to so considerable an amount as to make some change desirable in the policy to be further pursued. It became apparent that the purpose Professor Tyndall had in view could be better accomplished through the agency of permanent educational institutions, having among their objects the promotion of higher scientific study. The trustees corresponded with Professor Tyndall, who concurred with this view, and it was then resolved to terminate the existing arrangement by transferring the Tyndall fund back to the possession of the donor, to be distributed to such institutions as he might select. The original amount—thirteen thousand dollars—had increased to thirty-two thousand four hundred dollars; and Professor Tyndall decided to divide this sum in three equal amounts, to be given, one to Columbia College, of New York; one to Harvard University, of Cambridge; and one to the University of Pennsylvania, at Philadelphia, for the foundation of three permanent scholarships in physical science, and for the benefit of students desiring to prepare themselves for the work of original research either at home or abroad, as the authorities of the respective institutions might decide.

This princely benefaction to American science will thus be memorable in future times, not only for its magnitude, but from the impressive circumstances of its origin. The money represents the contributions of the American people, given for the enjoyment of one of the most striking and instructive courses of scientific lectures ever delivered in this country. It represents also the earnings of one of the most gifted and high-minded scientific men of this generation, who contributed half a year's labor to the preparation and delivery of the lectures. The fund is consecrated to the perpetual carrying out of the scientific conceptions and principles inculcated in these discourses, so that the intellectual influence so strikingly initiated thirteen years ago will be an enduring power in the higher scientific education of this country for all time. Three of our leading collegiate institutions will be in competition with each other to administer these scholarships in the spirit in which they have been founded, to maintain their high-class character, which will be evinced by the quality of the men they turn out, and who, by their accomplishments, will do lasting honor to the illustrious scientist whose name and fame are treasured in the hearts of many thousands of the American people.

OFFICIALISM IN EDUCATION.

THE Boston "Journal of Education" complains of the persistent assaults made upon "the graded school system" of this country, and attributes very evil motives to those by whom the alleged assaults are conducted. It finds "a considerable class of the clergy of all sects laced up in the mediæval European notion that the priest has a divine right to supervise all schools, overriding even the claim of the family, and resenting the claim of the whole people to supervise education as a godless presumption." It mentions also "a growing class of scientists, scholars, and literary people" as "putting on European airs, and claiming the exclusive right, as educational experts, to control the schools." Next, there is an exclusive social class bent on "forcing its own lines of artificial distinction into the school-room." The moneyed class, again, wants to regulate education with a view to keeping the "common herd" out of the poor-house; while labor-reformers want to have the interests of the mechanic and operative classes specially considered.

Now, we must confess that we fail

to see that the account given by our contemporary—presuming it to be correct—of the views of the several classes mentioned bears out the statement that these classes are persistently assaulting the graded school system. So long as the school system belongs to the domain of politics, as it does, so long will it be open to criticism from any and every quarter. The humblest individual in the community has a right to express his opinion as to how public money should or should not be spent; but we are not cognizant of any efforts that are being made to undermine the "graded" system as such. That it is desirable to have educational institutions of every grade, from the lowest to the highest, no sensible person is likely to deny; though some might raise the question as to whether enforced taxation is the proper means of obtaining funds for certain kinds of education. If our contemporary thinks that even to raise such a question is to show hostility to the cause of education, we must beg leave to differ from him. Time was when no one could imagine that anybody not a foe to religion could propose to sever church from state; but at present the great majority, in this country at least, hold that the severance is decidedly in the interest of religion. It may be said to be all but universally agreed that people are quite able to provide themselves with religion without any help from the state; and, moreover, that the article they provide for themselves is likely to be a considerable improvement on what the state has ever doled out. Well, it may require a far greater stretch of radicalism to hold that people could also provide themselves with intellectual enlightenment without state assistance; but we are not prepared to say that he who takes up this position is necessarily either a "crank" or an enemy of society. The fact is, that the article from which we have quoted betrays just a *soupçon* of the bureaucratic spirit which naturally develops itself in connection with all state management. Those who control the schools in the name of "the whole people" do not like the clergy to have any special views of their own in regard to the moral aspects of public-school education. They do not relish the criticisms of "scientists, scholars, and literary people" who venture to find the educational machine rather too much of a machine, and its work slightly wanting in organic variety. They want to be allowed to run the machine in the way most convenient to themselves and most favorable to large visible results. We do not question for a moment that much of sincere endeavor after the best results accompanies the administration of the official system; but we do mean that, in every official system, the official or bureaucratic spirit is a constantly growing force, and must tend to a stereotyping of methods and to a more or less barren uniformity in the minds molded under its influence. The time may come when it will be seen to be as much in the interest of true intellectual liberty that education should be freed from state trammels as it is now seen to be in the interest of religious liberty that the state should abstain from interference in the spiritual concerns of the people. Meantime it is a clear sign of the development of the bureaucratic spirit in connection with education when criticism from any quarter is looked on with an evil eye, and when "scientists, scholars, and literary people," and all others who have any special views of their own on the subject, are more or less politely warned off the premises.

CURIOUS EXCUSES FOR WAR.

THERE is little need of evidence to show the popularity of war, yet the reprobation it meets with from the growing moral sense of the world sometimes puts its advocates upon strange defenses of it. Though always a dire

calamity, war is in certain circumstances to be defended as a necessity; but those who make it a business are rarely contented to leave it on this ground. The brutal bluntness of the member of Parliament who advocated war in a distant English province, and, upon being pressed for his reasons, replied, "Why, d—n it, I have two sons in the army!" is not often emulated; even those who are interested in it as a vocation seek plausible excuses for it.

Lieutenant-Commander Goodrich, of the United States Navy, for example, writes, in the "Century Magazine": "I am not sure, however, that it is not well once in a while to assert ourselves as standing on a right because it *is* right, and as prepared to maintain it at any cost." It would seem the dictate of a wise statesmanship, on a matter of such supreme importance, to lay down the principles that should govern a nation, in resorting to war, as an established and inflexible policy. But Lieutenant Goodrich seems to think that war may be desirable, once in a while, anyhow or on its own account, or as a display of power, without reference to its usual provocations.

War is generally regarded as a last brutal resort, when the higher agencies of reason and diplomacy have failed, and the resources of civilization to keep the peace have broken down; but Von Moltke maintains that war is itself a natural and permanent element of civilization, and that the hope of ending it is equally illusive and undesirable.

But the most curious attempt to throw a glamour over the intrinsic abominations of war, and make it seem a thing worthy of admiration, is made by the "Spectator," which maintains that, in the systematic and professional killing of men on a vast scale, which constitutes war, there is a peculiar "intellectual charm." The "Spectator" intimates that Christians of the feminine type, and sentimental people who vividly realize the horrors of battle, may shrink from the system; but it says that "war, as such, has for cultivated mankind a distinct intellectual charm." The terrible fascination is admitted, but how its charm can be qualified as distinctly intellectual does not appear. The "Spectator" expatiates on the tremendous interests staked in war, which may involve the national fate, and be of immense moment to citizens; but, then, it goes on to say, "Wars which are not ours interest us nearly as much as those which are." The truth is, war appeals not so especially to the intellect as to the deeper life-instincts of humanity. Men are thrilled by the excitement of war with no regard to their culture. There is no more "intellectual charm" in war than in any great crime or catastrophe or the coming of cholera. It is probable, indeed, that the "Spectator" has here committed itself to the very opposite of what is true. It is impossible to think of the intellectual classes as such, people of cultivated sensibilities, except as repelled and shocked instead of being charmed by war; while, on the contrary, the distinctively uncultivated classes are most profoundly stirred and attracted by it. The admiration of war is indeed the deepest among savages and barbarians, with whose undeveloped natures it is in harmony. The recent war-experiment of the "Century Magazine" is said to have doubled its circulation; will it be claimed that the hundred thousand new patrons that have been found in addition to its former readers, are to be ranked as especially intellectual and cultivated, or are they not probably quite of the opposite kind?

LITERARY NOTICES.

TRANSACTIONS OF THE NEW YORK STATE MEDICAL ASSOCIATION FOR THE YEAR 1884. Edited, for the Association, by Dr. AUSTIN FLINT, Jr. New York: D. Appleton & Co. Pp. 654. Price, $5.

THE first meeting of the Association was held in the city of New York on the 18th,

19th, and 20th, of November, 1884, and was attended by two hundred and forty-two fellows. The titles of fifty papers to be read were entered on the official programme of the meeting, by members representing fifteen counties of the State, besides papers the titles of which were received after the programme was published. Of these papers, seventeen were on topics of surgery, fifteen on medicine, eleven on obstetrics and gynæcology, three on ophthalmology, two on materia medica, one on physiology, and one on insanity. The present volume contains three papers, with the president's (Henry D. Didama, M. D., of Onondaga County) annual address, lists of officers and council, fellows, etc.; the "Articles of Incorporation and Constitution and By-laws"; the "Code of Medical Ethics"; the "Proceedings of the Annual Meeting"; and the "Report and Minutes of the Council."

REPRESENTATIVE AMERICAN ORATORS. To illustrate American Political History. Edited, with Introductions, by ALEXANDER JOHNSTON. New York: G. P. Putnam's Sons. 3 vols. Pp. 282, 314, 405. Price, $3.75.

THE present generation of Americans is far behind the one that preceded it in a realizing knowledge of the political history of our country and of the principles on which our government is founded. The civil war and its sequences seem to have obscured the living knowledge of our earlier history, and left it nearly as colorless as some matter of a remote age; while the anomalous measures that have had to be devised to meet the unprecedented exigencies of the last twenty-five years have tended to consign the safe traditions of our old statesmen to oblivion, and contributed to the spread of novel and dangerous heresies. Hence we regard anything that will help to make living again among us the fundamental principles of American politics and the debates of the past, and the ultimate objects which our statesmen sought to reach, as of public benefit. We can conceive nothing better adapted to set these matters vividly before American youth than the orderly presentment of the best and most pertinent words of the best orators who took part in the shaping of them, such as Mr. Johnston has aimed to make in these three volumes. His compilation is divided into seven parts, illustrating seven epochs in our history: "Colonialism, to 1789"; "Constitutional Government, to 1801"; "The Rise of Democracy, to 1815"; "The Rise of Nationality, to 1840"; "The Slavery Struggle, to 1860"; "Secession and Reconstruction, to 1876"; and "Free Trade and Protection"; in all of which, except the last, a kind of chronological order is maintained. In each of these epochs the orators are presented, so far as is found practicable, on either side, whose voices were most potent in putting the issues into shape and molding opinion upon them. The earlier periods are represented, among other orators, by Patrick Henry, Hamilton, Washington, Fisher Ames, Jefferson, Randolph, Quincy, Clay, Hayne, and Webster; the issues of the antislavery struggle by Phillips, Clay, Sumner, Douglas, Preston Brooks, Burlingame, Lincoln, Breckinridge, and Seward; and the periods of secession and reconstruction by other names equally prominent and representative; while the question of "Free Trade and Protection" is illustrated by Henry Clay's "The American System," and Frank Hurd's "Tariff for Revenue only." Each of the groups of orations is preceded by an introduction giving the historical thread by which the speeches were connected, and describing the condition of the questions to which they related.

AFGHANISTAN AND THE ANGLO-RUSSIAN DISPUTE. By THEODORE F. RODENBOUGH. New York: G. P. Putnam's Sons. Pp. 139, with Maps and Illustrations. Price, 50 cents.

THIS is a convenient hand-book for persons wishing to follow the Afghanistan question, which is yet, despite the seemingly smiling aspect of the negotiations, far from settled. It gives a plain view of the situation as it was at the moment when the recent passages between England and Russia began to be lively. It first relates the successive steps by which Russia has advanced during the last century and a half from the Ural into Central Asia, and to its present position near the Afghan frontier. This history is followed by accounts of "the British forces and routes," and "the Russian forces and approaches," and by a review of the military situation.

AN INGLORIOUS COLUMBUS; or, Evidence that Hwui Shăn and a Party of Buddhist Monks, from Afghanistan, discovered America in the Fifth Century A. D. By EDWARD P. VINING. New York: D. Appleton & Co. Pp. 788, with Map. Price, $5.

THE term "inglorious" is not intended to be applied to our Christopher Columbus, but, in the sense in which Gray, in his "Elegy," speaks of "some mute, inglorious Milton," to the Buddhist monk who, known only to a few special scholars, has failed to receive the universality of fame which should be his due. According to the author's statement, and as is known to Asiatic scholars, there is, among the records of China, an account of a Buddhist priest who, in the year 499 A. D., reached China, and stated that he had returned from a trip to a country lying an immense distance east. In the case of other travelers, whose narratives are also preserved in ancient Chinese literature, the accounts which we possess of their journeys were either written by themselves or their followers; but, in the case of Hwui Shăn, the interest excited in his story was so great that the imperial historiographer, whose duty it was to record the principal events of the time, entered upon his official records a digest of the information obtained from the traveler as to the country which he had visited. It is this official record, or rather a copy of it contained in the writings of Ma Twanlin, which is discussed in this work. But little doubt, if any, exists as to the authenticity of the record, but there are considerable differences of opinion respecting what country it was which the monks (who were missionaries of Buddhism) visited, and described as Fusang. Some of the critics believe it to have been Japan, others America. Mr. Vining believes it was Mexico, and, in adducing the considerations to support his belief, he transcribes, or makes a summary of, all the papers that have been written on the subject, except Mr. Leland's large book, which readers are advised to buy. He believes that the route followed by the priests, which is obscurely described in their itinerary, was from Japan, or the Asiatic mainland, along the course of the Aleutian Islands—"the land of the marked bodies"—to Alaska—"the Great Han"—and thence along the Pacific coast to the "land of the Fusang-tree," which plant is not yet identified, and the "country of women," in Mexico. Among the arguments relied upon to support this view, are the correspondences of distances, which, according to Mr. Vining's computations, are close enough; the description of the country of Fusang, the customs of its people, and the characteristics of its vegetation, which is faithful as to Mexico, and includes details that would not be true of any other country; accounts, in the traditions of Mexico, of the arrival of a party of men similar to what the Buddhist party must have been; and the state of civilization in Mexico at the time of the arrival of the Spaniards, which was such as might have grown up from an Asiatic implantation. On the other hand, the history of Japan is reviewed, for the purpose of showing that that could not have been the country visited. The book also contains a translation of that part of the "Chinese Classic of Mountains and Seas" which relates to lands east of China—a work which is thought to be the oldest geography of the world, and which has never before been translated into any European language.

ASSYRIOLOGY: ITS USE AND ABUSE IN OLD TESTAMENT STUDY. By FRANCIS BROWN. New York: Charles Scribner's Sons. Pp. 96. Price, $1.

THE author of this book is Associate Professor of Biblical Theology in Union Theological Seminary in this city. The purpose of the book is to utter a caution against too hasty and extensive generalizations upon the discoveries that are made, one at a time, amid much groping in the dark, among the ruins of the ancient empires of the East, and which often seem to have a bearing upon the records given in the Bible. It is human nature to grasp eagerly at evidence that seems to favor what one wants proved, and to reject obstinately what seems of an opposite character; and biblical scholars are prone to the fault. Professor Brown advises such to wait in matters of Assyriology for the results of searching criticism. The discoveries in that field, though undoubtedly destined in the end to be of vast importance, are, many of them—not all—as yet too fragmentary and uncertain to build any-

thing on that must depend upon them. The cause of truth may be injured by overhaste; it can only be benefited by deliberation and careful examination.

LOCAL INSTITUTIONS IN VIRGINIA. By EDWARD INGLE. Baltimore: N. Murray. Pp. 127. Price, 75 cents.

THIS essay, constituting numbers two and three of the third series of the "Johns Hopkins University Studies in Historical and Political Science," is not inferior in interest and importance to any of the numbers of either series that has preceded it. Virginia was a "mother of commonwealths," and the results of her development and her policy were impressed, in one shape or another, and to a greater or less extent, in Kentucky and the States that were formed out of the Northwest Territory. The purpose of Mr. Ingle's study is to ascertain from what these results were developed, and how. In pursuing it, he considers the character of the country and its settlers ("Virginia and the Virginians") "The Land-Tenure of the Colony," "The Organization of the Hundred," "The Fortunes of the English Parish in America," "The County System of Colonial Virginia," and "The Town." Under the last head, the curious fact is developed that towns which in other States appear variously as the original form of settlement, of spontaneous growth, or as the ready creatures of speculation, were not natural to Virginia; and that the formation of them was the object of several laborious efforts, prosecuted against a chronic indisposition of the people to settle in them or to favor them at all.

GEOLOGY OF THE COMSTOCK LODE AND THE WASHOE DISTRICT. By GEORGE F. BECKER. Pp. 422, with Plates and an Atlas. Price, $11. COMSTOCK MINING AND MINERS. By ELIOT LORD. Pp. 451.

THE surveys upon which Mr. Becker's report is based were conducted by him as aid to Mr. Clarence King, and chiefly in the lower parts of the lode. Mr. King has already made the upper part familiar to geologists. In his work Mr. Becker had the assistance of Dr. Carl Barus, physicist, who made researches in the electrical activity of ore-bodies and in kaolinization, the results of which are incorporated here. In the report, the general account of the Comstock mines and the review of previous investigations of the lode are followed by chapters on the "Lithology of the Washoe District," with detailed descriptions of sections of the rocks prepared for microscopic examination; on the structural results of faulting, the occurrence and succession of the rocks, the heat-phenomena of the lode, and Dr. Barus's papers on "Kaolinization and on the Electrical Activity of Ore-Bodies." The relations of the minerals and the changes they have undergone are discussed very fully in the chapters on "Lithology" and "Chemistry," and the character and causes of the heat-phenomena of the lode, with the various theories that have been proposed to account for them, as fully in the chapter on that subject. These heat-phenomena are one of the most famous peculiarities of the Comstock Lode, and distinguish it from all other mines and excavations under the earth's surface. The unusually high temperature was manifested in the upper levels, and has increased with the depth. The present workings are intensely hot; and, during the winter of 1880–'81, the water in one of the levels reached a temperature of 170° Fahr., at which food may be cooked, and the human epidermis is destroyed. The rapidity of the ventilation required to reduce the temperature of the air is something unknown elsewhere, yet deaths in ventilated workings from heat alone are common, and there are drifts which without ventilation the most seasoned miner can not enter for a moment. The origin of this high temperature has been attributed to the kaolinization of the feldspar in the country rock and to residual volcanic activity. No positive evidence is adduced that it is due to kaolinization, and the results of Dr. Barus's experiments on the thermal effect of the action of aqueous vapor on feldspathic rocks, so far as they have been carried out, were wholly negative. No heating effect due to this cause could be detected with an apparatus delicate enough to register a change of temperature of one thousandth of a degree C. On the other hand, there is much geological evidence pointing to a deep-seated source of heat, probably of volcanic origin, or solfataric. The floods of waters which have been met in the mines can not be accounted for by any hypothesis connect-

ed with the rainfall of the district. Mr. Becker proposes a theory that the Comstock fissure taps water-ways leading from the crests of the great range of the Sierra Nevada. Under this theory, if the heat is conveyed to the lode by water from great depths, the variations in temperature are readily explained, by supposing variations in the distribution of the heated water.

Mr. Lord's volume—"Comstock Mining and Miners"—is chiefly historical, and has a peculiar interest in that it describes an episode in the development of one of the most important American enterprises, and relates one of the most wonderful stories in mine-working that it has ever been given to tell. The dangers faced by the miners from the extreme heat and other causes are vividly sketched. "The service demonstrates anew how elastic are the limits of human endurance when men are drawn on by some masterful passion. The bounds of possibility then confine their achievements but not their attempts. . . . Death alone has the power to say to miners, 'Thus far shall ye go and no farther!'—for no endurable suffering will bar their progress; nor will the loss of life even make them pause, unless the scourge of heat shall strike them down like a pestilence. Of late years heat has killed strong men in almost every deep mine in the lode, and in some mines the deaths so caused have been frequent." The ultimate effect of this extreme heat on the miner's constitution, even when it does not result in immediate death, is also to be considered; and, besides this, all the ordinary dangers of deep mining exist here in aggravated forms.

CONTRIBUTIONS TO THE FOSSIL FLORA OF THE WESTERN TERRITORIES. Part III. The Cretaceous and Tertiary Flora. By LEO LESQUEREUX. Washington: Government Printing-Office. Pp. 283, with 60 Plates.

THIS, although published under the direction of Major Powell, is the eighth volume of the Hayden reports. It contains, first, descriptions of the cretaceous flora, including a large number of new species, some representing rare and very remarkable plants, accompanied with general remarks on the geology of the Dakota group, and on the character of the plants with regard to climate and their affinities with plants of succeeding geological periods. The second part contains a revision of the plants of the Laramie group. The third part reviews the floras of the White and Green River regions, which are separated into two groups. The relations of these plants with the flora of the Gypses of Aix, France, which is generally regarded as of the lowest Miocene or Oligocene, are indicated. The fourth part relates to Miocene plants described from specimens obtained from the Bad Lands, California, and Oregon. The plants of the cretaceous Dakota group, as known mostly from their detached leaves, are striking from the beauty, the elegance, and the variety of their forms, and from their size. The multiplicity of forms recognized for a single species is quite as marked as it might be upon any tree of our forests. In analyzing the leaves by detail, "we are by-and-by forcibly impressed by the strangeness of the characters of some of them, which seem at variance with any of those recognized anywhere in the floras of our time, and unobserved also in those of the geological intermediate periods. Not less surprised are we to see united in a single leaf, or species, characters which are now generally found separated in far-distant families of plants." The flora of the Laramie group (Eocene) is quite distinct from the cretaceous. The Green River group includes the famous Florissante Basin, of which we have already given some account. The Miocene plants, which are described by groups according to where they occur, have not been sufficiently recovered to authorize any reliable conclusion regarding their relative stage in either group.

MADAM HOW AND LADY WHY. By CHARLES KINGSLEY. New York: Macmillan & Co. Pp. 321. Price, 50 cents.

THIS book, which now appears in a convenient volume of the series of "Globe Readings from Standard Authors," is described in the title-page as "First Lessons in Earth-Lore for Children." It presents, in the form of a pleasing allegory, the workings of the geological agencies that have contributed to the shaping of the globe, and the present appearance of its surface, and their results; the operations being supposed to be performed by a "Madam How," under the direction of a mysterious "Lady Why."

PHOTO-MICROGRAPHY. By A. COWLEY MALLEY, F. R. M. S. Second edition. London: H. K. Lewis, 136 Gower Street, Pp. 166.

DRAWING can not be wholly relied upon for the representation of minute microscopic objects, because of the difficulty of seeing such delicate things accurately, and of commanding the pencil to give a perfectly correct reproduction of what is seen. At the best, a drawing is apt to show evidence of preconceived notions of the structure in the mind of the observer. Photography, though not infallible, always accurately returns what is sent to the plate, and is almost universally true. In the present work, the author gives the methods he has himself adopted, and the most applicable parts of the methods used by others; and, by showing the facility of their application, he hopes to make photo-micrography more popular, and place it within the reach of all. In this second edition have been incorporated the advances that have been made in microscopy, and the more recent improvements in photography. Descriptions of the wet collodion and gelatino-bromide processes, and of the best methods of mounting and preparing microscopic objects for photo-micrography, are given.

THE OCCULT WORLD. By A. P. SINNETT. Second American, from the fourth English edition, with the Author's Corrections and a New Preface. Boston: Houghton, Mifflin & Co. Pp. 228. $1.25.

THE readers of "The Popular Science Monthly" have already been informed, to some extent, respecting the doctrines of the theosophists, of which this may be considered one of the text-books. Among their beliefs is that in the existence among some privileged or specially instructed classes of persons of mysterious knowledge and power which are hidden from the mass of mankind, to which are referred and by which may be explained many wonderful things in ancient and modern lore, the reality of which appears supported by evidence we can not despise, but belief in which, so contrary are they to our ideas of nature, taxes the most credulous. The "science" which represents this knowledge and power has made some advances since the first edition of "The Occult World" was published, and its votaries believe that they have received additional confirmation of its reality. The new developments are given in the form of additional matter and notes, the original text of the book having been changed but little.

RUSSIA UNDER THE TZARS. By STEPNIAK, author of "Underground Russia." New York: Charles Scribner's Sons. Pp. 381. Price, $1.50..

THIS book is divided into three parts. In Part I, "The Past," is shown how the original fundamental principle of the Russian Government was the sovereignty of the people, full, free, spontaneous, and indisputable in the highest possible degree, as it still is in the *Mir*, or the rural communes; and how Czarism gained a footing, and gradually crushed that sovereignty entirely out within the empire at large, and in all the great centers. Part II, "Dark Places," is made up of the relations of incidents in the lives of political suspects and their experiences with the police. In Part III "Administrative Exiles" are described, a number of features characterizing the despotism of the military and the police, and the measures of administrative repression which the Government is compelled to adopt in its struggles against the forces of human nature to which it has set itself in opposition.

THIRD ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL SURVEY, 1881, 1882. By J. W. POWELL, Director. Washington: Government Printing-Office. Pp. 564, with Plates.

THIS volume contains the reports of progress for the year of the heads of the divisions of the survey, and six monographs on special features of the survey. The administrative reports are, that of Mr. Clarence King, prepared for him in his absence by Dr. Carl Barus, on the "Determinations of the Physical Constants of Rocks"; of Mr. Arnold Hague, on "Operations in the Division of the Pacific"; of Mr. C. K. Gilbert, of the "Division of the Great Basin, chiefly relating to the Survey of the Quaternary Lake Bonneville"; of Mr. T. C. Chamberlin, on the "Survey of the Glacial Moraine, from the North Border of Dakota to the Atlantic"; of Mr. S. F. Emmons, of the "Division of the Rocky Mountains"; of Mr. G.

F. Becker, on the "Comstock Lode and the Washoe District"; of Mr. Lester F. Ward, on "Vegetable Paleontology"; and of Messrs. J. Howard Gore and Gilbert Thompson, on "Triangulations and Topographical Surveys." The "accompanying papers" are those of Professor O. C. Marsh, on "Birds with Teeth"; of Roland D. Irving, on the "Copper-bearing Rocks of Lake Superior"; of Israel C. Russell, on the "Geological History of Lake Lahontan"; of Mr. Arnold Hague, on the "Geology of the Eureka District"; of Mr. T. C. Chamberlin, on the "Terminal Moraine"; and of Dr. C. A. White, on the "Non-Marine Fossil Mollusca of North America." Mr. Hague's preliminary report promises much interesting information when the papers are published in full, concerning the lithological structure of the volcanic cones of Mounts Rainier, Hood, Shasta, and Lassen's Peak, which play so important a part in the geology of the Sierra Nevada and Cascade Ranges. Mr. Chamberlin's paper reveals the interesting facts that the glacial moraine formation consists, not of a single moraine, but of a group of three or more concentric and rudely parallel ones, that sometimes coalesce and sometimes separate, so as to occupy a belt occasionally twenty or thirty miles in width; that the individual moraines, instead of being sharp ridges, consist of a broad belt of irregular, tumultuous hills and hollows, giving rise to a peculiar knob-and-basin topography; that the massiveness of the moraine finds its development in great width rather than in abrupt and conspicuous height; that throughout a considerable portion of its course, instead of pursuing a direct or moderately undulatory line, it is disposed in great loops, formed at the margins of ice-tongues, between which re-entrant portions formed extensive intermediate moraines; and that these ice-tongues occupied the great valleys of the interior, and manifestly owed their origin to topographical influences. Mr. Becker mentions the interesting fact that in the caves above the ore-bodies, on Ruby Hill, the crystals of aragonite are still in process of rapid formation; and Mr. Curtis is conducting accurate experiments to ascertain the rate of growth and the physical and chemical conditions attending their formation.

TABLES TO FACILITATE CHEMICAL CALCULATIONS. Compiled by W. DITTMAR, F. R. S. Second edition. London: Williams & Norgate. Pp. 43, small 4to. Price, 5 shillings.

THIS little volume contains tables of atomic weights, analytical factors, logarithms, reciprocals, physical constants of gases, etc., together with rules for gasometry, a chapter on the arithmetic of gas analysis, and other minor data, of value for daily reference in the laboratory. Its utility to the analyst is obvious, although, to a well-trained chemist, much of the matter contained in it is too familiar to need quotation in this form. To the elementary student, on the other hand, works of this character are of questionable value. The pupil who works out his analysis by the aid of factors too often fails to learn the principles upon which they depend, and does not acquire that command of stoichiometry which every good chemist should have. Of its kind, however, and in its proper place, the volume appears to be satisfactory. It is announced as being preliminary to a forthcoming work upon chemical arithmetic, which, when issued, will replace it.

CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY. Vol. V. Washington: Government Printing-Office. Pp. about 400, with Plates.

IN this volume are bound up the monographs of Mr. Charles Rau, on "Cup-shaped and other Lapidarian Sculpture in the Old World and in America"; of Dr. Robert Fletcher, on "Prehistoric Trephining and Cranial Amulets"; and of Dr. Cyrus Thomas, on the "Manuscript Troano." The last two works have already been fully noticed by us. Mr. Rau's paper relates to some curious kinds of rock-sculptures, which are described as "cups" of various sizes, rings surrounding the "cups," or independent of them, and other designs, which have been found on rocks, and on and near megalithic stones and buildings, in various parts of Europe, and similar figures which have been discovered in America. The origin and purpose of these designs have been variously accounted for. Some persons regard them as Phœnician Baal sculptures; some as originating at a remote period in the history of the Aryan race; some as having a phallic

significance; some as direction-marks, etc. Mr. Rau suggests that some of the smaller cup-stones may have been used for cracking nuts, and others as paint-cups. Another class of American relics coming under this category consists of stones of larger size, on which several cup-like cavities are worked out. They usually occur as flat fragments of sandstone without definite contours. The cups are either on one of the flat surfaces or on both, and their number on a surface varies, so far as has been observed, from two to ten. They are irregularly distributed, and generally measure an inch and a half in diameter, but sometimes less. According to Colonel Charles Whittlesey, these stones occur quite frequently in Northern Ohio, more particularly in the valley of the Cuyahoga River, while he is not aware of any having been found in the mounds. He believes the holes were sockets in which spindles were made to revolve, and calls the stones "spindle-socket stones," but Mr. Rau does not agree with him. A bowlder in the rooms of the Society of Natural History, of Cincinnati, which was found near Ironton, Ohio, weighing between one thousand and twelve hundred pounds, contains one hundred and sixteen of these cups. A bowlder found at Niantic, Connecticut, has six cups, with a number of lines, which may be natural. Stones, bearing figures resembling these, appear worked into the walls of churches, and the designs may be found even in holy-water fonts. Altogether, the cup-stones present a curious field of inquiry. Mr. Rau considers the forms more or less related, and as having a similar origin and meaning; as to what these are, he is inclined to agree with M. Rivett-Carnac, in attributing to them a significance like that indicated in the Siva figures of India.

THE LENAPÉ AND THEIR LEGENDS: with the Complete Text and Symbols of the Walam Olum. By DANIEL G. BRINTON. Philadelphia: D. G. Brinton. Pp. 262.

IN the present volume, which is the fifth in his "Library of Aboriginal American Literature," Dr. Brinton has grouped a series of ethnological studies of the Indians of Eastern Pennsylvania, New Jersey, and Maryland, around what is asserted to be one of the most curious records of ancient American history—the "Walam Olum," or Red Score. The interest in the subject excited by his inquiries into the authenticity of this document prompted him to a general review of our knowledge of the Lenapé, or Delawares, of their history and traditions, and of their languages and customs. This study disclosed the existence of manuscripts not mentioned in the bibliographies. Whether the Walam Olum be genuine or not—concerning which Dr. Brinton does not express a decisive opinion, though his inquiries have resulted favorably to its being regarded as an oral reproduction of a genuine native work, repeated to some one indifferently conversant with the Delaware language, who wrote it down to the best of his ability—it is believed that there is sufficient in the volume to justify its appearance, apart from that document.

THE PHILOSOPHIC GRAMMAR OF AMERICAN LANGUAGES, AS SET FORTH BY WILHELM VON HUMBOLDT. By DANIEL G. BRINTON, M. D. Philadelphia: McCalla & Stavely. Pp. 51.

THE philosophy of language owes much to Wilhelm von Humboldt, who was its substantial founder. The American languages occupied his attention for many years, and he wrote to Alexander von Rennenkampff, in 1812, that he had selected them as the special subject of his investigations. He was often accustomed to draw "illustrations of his principles from them, and in every way showed a high appreciation of their importance. In the present essay, Dr. Brinton has given a general exposition of Humboldt's views on these languages, and studies of them, and has added the translation of an unpublished memoir by him on the American verb, which was originally read before the Berlin Academy of Sciences, and of which only the manuscript is preserved in the Royal Library at Berlin.

THE PROTESTANT FAITH; OR SALVATION BY BELIEF. By DWIGHT HINCKLEY OLMSTEAD. New York: G. P. Putnam's Sons. Pp. 77. Price, 50 cents.

THE author styles this work "An Essay on the Errors of the Protestant Church," those errors consisting, in his vision, principally in the imposition of an intellectual belief in certain doctrines as a fundamental conditionof salvation.

MAN'S BIRTHRIGHT, OR THE HIGHER LAW OF PROPERTY. By EDWARD H. G. CLARK. New York: G. P. Putnam's Sons. Pp. 133. Price, 75 cents.

THIS work seems to be the result of an attempt by the author to edit the "Ownership and Sovereignty" of Mr. David Reese Smith. The theory of that book was judged correct, but very inadequately presented; hence this attempt to redress, rearrange, and elaborate it from beginning to end. Mr. Clark accepts Henry George's theory of the right of each generation to own the soil, but differs from him as to the manner in which it is to be carried out. He announces the true law of ownership to be: "Mankind as a whole own the entire wealth of the world, natural and fabricated; but every individual in the world can command and control any piece of that wealth according to his normal purchasing power, which is the exact index of the value of his labor, his skill, his pecuniary ability. But, if he wishes to set aside for his private uses any portion of the general wealth, whether the piece of property contains his own labor or that of some one else, then he must pay on that piece of property the rest of the people's share of value bound up in it; and, if every other member of society pays his appropriate share of such values, exact justice is reached in every respect." This share is calculated to be an *ad valorem* tax on the property of every generation, exactly proportioned to the death-rate of the population.

HEGEL'S ÆSTHETICS: A Critical Exposition. By JOHN STEINFORD KEDNEY. Chicago: S. C. Griggs & Co. Pp. 302. Price, $1.25.

THIS is the fourth volume of Messrs. Griggs & Co.'s series of "German Philosophical Classics," the design of which is to present, under the editorial supervision of competent American scholars, the more essential parts of the important works of the masters of German thought. Hegel's "Æsthetics" is one of the most important works on the subject in existence, but it is voluminous. In the present adaptation, the first part, which gives the fundamental philosophy of the whole, is reproduced faithfully, but in a condensed form, with criticisms by the editor interspersed. A translation of the second part, which traces the logical and historical development of the art-impulse, being easily accessible (D. Appleton & Co.), the editor has substituted for it an original disquisition having more immediate regard to present æsthetic problems, but in a line with Hegel's thought. Of the third part, all the important definitions and fundamental ideas are given, but the minute illustrations and the properly technical part are omitted.

THE INVALID'S TEA-TRAY. By SUSAN ANNA BROWN. Boston: J. R. Osgood & Co. Pp. 67. Price, 50 cents.

A DAINTY volume, as becomes a book of recipes of dishes designed to tempt the dainty appetite of an invalid. It contains fifty or more such recipes, of those things which are considered best adapted to the invalid's condition, most nourishing or most easily digested, according as that condition may require; for the serving of which "the first requisite is absolute neatness." Also, the author says, "vary the meals as much as possible, and let each little delicacy be a surprise. Have the hot things really hot, and the cold ones perfectly cold; and offer only a very small quantity of food at a time, or you will never be able to tempt the capricious appetite of an invalid."

MATERIALS FOR GERMAN PROSE COMPOSITION. By C. A. BUCHHEIM. New York: G. P. Putnam's Sons. Pp. 252. Price, $1.25.

THIS book consists of selections from modern English writers, to be translated into German, to aid in which work grammatical notes are furnished, with idiomatic renderings of difficult passages, a general introduction, and a grammatical index. It has been the compiler's purpose to furnish a practical and theoretical guide to persons who, having a full knowledge of German accidence, and of the rules of the order of words, desire to gain skill in translating from English into German. The extracts have been made from the body of the author's work, with deliberate avoidance of "hackneyed" passages, and from the more modern authors. The matter is graduated into four parts, beginning with easy, detached sentences and minor extracts, and rising to more difficult passages and those involving idiomatic construction.

ON OXYGEN AS A REMEDIAL AGENT. By SAMUEL S. WALLIAN, M. D. New York: Trow's Company. Pp. 52.

DR. WALLIAN holds that oxygen stands at the head of the list of natural agencies for the removal of disease, and that "it is quite time we should practically realize, for we already theoretically admit, that this omnipresent, almost omnipotent, and yet commonplace element, can not be replaced, scarcely supplemented; that there is no known alterative, eliminator, or disinfectant comparable with it; . . . and that the original, normal, and only unobjectionable and universally efficient antiseptic is pure oxygen. . . . As a therapeutic agent, oxygen is not yet popular, nor yet the fashion; although for years enterprising quacks have been gathering a generous harvest, from honest dupes who have sickened of cruder quackery, by broadcast heralding of the magic virtues of some impossible 'compound' of it. Is it not high time that its intelligent use should be undertaken at the hands of legitimate and competent physicians, who have no secret wares to hawk about the country?"

PUBLICATIONS RECEIVED.

Sanitary Suggestions. How to disinfect our Homes. By B. W. Palmer, M. D. Detroit, Mich.: George S. Davis. 1885. Pp. 58. 25 cents.

Ethical Culture. Four Lectures. By Samuel Burns Weston. Philadelphia. 1885. Pp. 70. 20 cents.

The Abdominal Brain. By Leila G. Bedell, M. D. Chicago: Gross & Delbridge. 1885. Pp. 45.

A New Philological Theory. By Professor A. J. Mogyorosi, Allegany, N. Y. Buffalo: Lockwood & Ough, Printers. 1885. Pp. 11.

Foul Brood. Its Management and Care. By D. A. Jones. Press of "Canadian Bee Journal," Beeton, Ontario. Pp. 32. 10 cents.

Shall we hang the Insane who commit Homicides? By Clark Bell, Esq., of New York. Reprinted from the "Medico-Legal Journal." Pp. 40.

Illinois State Board of Health. Sanitary Schedule of the State Sanitary Survey.

The Biogen Series. No. 2. The Demon of Darwin. Coues. Pp. 64. No. 3. A Buddhist Catechism. Olcott. Pp. 84. 75 cents each.

The Composition of American Wheat and Corn. By Clifford Richardson. Washington: Government Printing-Office. 1884. Pp. 98.

Proceedings of the Modern Language Association of America, 1884. Baltimore. 1885. Pp. 100.

Actinism. By Professor C. F. Himes, Ph. D. Reprinted from the "Journal of the Franklin Institute," May, 1885. Pp. 22. Illustrated.

The Periodical Cicada. By Charles V. Riley, Ph. D. Washington: Government Printing-Office, 1885. Pp. 46. Illustrated.

Public Health in Minnesota. The Official Publication of the State Board of Health. Monthly. Vol. I, No. 2, April, 1885. Pp. 8.

Remarks upon Chipped Stone Implements. By F. W. Putnam. Salem, Mass. 1885. Pp. 8. Illustrated.

Bulletin of the Brookville Society of Natural History of Franklin County, Indiana. O. M. Meyncke & C. F. Goodwin, Editors. No. 1. 1885. Published by the Society. Pp. 45.

The "Sanitary Monitor." J. T. Winn, M. D., Editor. Monthly, Richmond, Va. Vol. I, No. 1, May, 1885. Pp. 14. $1 a year.

Descriptions of some Peculiar Screw-like Fossils from the Chemung Rocks. By Professor John S. Newberry. Reprint from the Annals of the New York Academy of Sciences. Pp. 4. Illustrated.

Local Institutions of Maryland. By Lewis W. Wilhelm, Ph. D. Baltimore: Johns Hopkins University. 1885. Pp. 129. $1.

Sixth Annual Report of the Archæological Institute of America. Cambridge: John Wilson & Son, 1885. Pp. 48.

Proceedings of the Biological Society of Washington. Smithsonian Institution, 1885. Vol. II. Pp. 195.

Bulletin of the United States Geological Survey, No. 2. On the Quaternary and Recent Mollusca of the Great Basin, with Descriptions of New Forms. By R. Ellsworth Call. Washington: Government Printing-Office. 1884. Pp. 56. Illustrated.

Transactions of the Society for the Promotion of Medical Science in Japan. Tokio, May, 1885.

Bulletin of the Des Moines Academy of Science. Des Moines, Ia. Published by the Academy. Vol. I, No. 1. 1885. Pp. 57.

Medical Thoughts of Shakespeare. By B. Rush Field, M. D. Easton, Pa. 1885. Pp. 86.

The Ohio State Sanitary Association. Proceedings of the Second Annual Meeting. From "The Sanitarian," May, 1885. Pp. 64.

Architectural Studies, Part I. Twelve Designs for Low-Cost Houses. New York: William T. Comstock. 1885.

International Electric Exhibition of 1884. Reports of the Examiners of Sections V, VI, and VIII. Electric Lamps. Carbons for Arc-Lamps. Philadelphia: The Franklin Institute. 1885. Pp. 12. Illustrated.

Healthy Foundations for Houses. By Glenn Brown. New York: D. Van Nostrand. 1885. Pp. 143. 50 cents.

Lectures on the Science and Art of Education. By the late Joseph Payne. Syracuse: C. W. Bardeen, 1885. Pp. 281. $1.

Practical Botany. By F. O. Bower, and Sidney H. Vines, with a Preface by W. Thiselton Dyer. London: Macmillan & Co. 1885. $1.50.

Matilda, Princess of England. A Romance of the Crusades. By Mme. Sophie Cottin. From the French by Jennie W. Rann. 2 vols. New York: W. S. Gottsberger. 1885. $1.75.

Talks Afield about Plants and the Science of Plants. By L. H. Bailey, Jr. Boston: Houghton, Mifflin & Co. 1885. Pp. 173. $1.

History of the Surplus Revenue of 1837. By Edward G. Bourne. New York: G. P. Putnam's Sons. 1885. Pp. 161. $1.25.

Forests and Forestry of Poland, Lithuania, the Ukraine, and the Baltic Provinces of Russia. Compiled by John Croumbie Brown, LL. D. Edinburgh: Oliver & Boyd. 1885. Pp. 276.

An Elementary Treatise on Hydro-Mechanics. By Edward A. Bowser, LL. D. New York: D. Van Nostrand. 1885. Pp. 298. $2.50.

List of Tests. By Hans M. Wilder. New York: P. W. Bedford. 1885. Pp. 88. $1.

Lessons in Elementary Practical Physics. By Balfour Stewart, F. R. S., and W. W. Haldane Gee. Vol. I. General Physical Processes. London: Macmillan & Co. 1885. Pp. 291. $1.50.

Properties of Matter. By P. G. Tait, R. S. E. Edinburgh: A. & C. Black. 1885. Pp. 320. $2.25.

The Q. P. Index Annual for 1884. Bangor: Q. P. Index, Publisher. 1885. Pp. 78.

The Magnetism of Iron and Steel Ships. By T. A. Lyons. Washington: Government Printing-Office. 1884. Pp. 121. Illustrated.

A Manual of the Theory and Practice of Topographical Surveying by Means of the Transit and Stadia. By J. H. Johnson, C. E. New York: John Wiley & Sons. 1885. Pp. 111. $1.25.

Commercial Organic Analysis. By Alfred H. Allen, F. C. S. Vol. I. Philadelphia: P. Blakiston, Son & Co. 1885. Pp. 476. $4.50.

The French Revolution. By Hippolyte Adolphe Taine, D. C. L. Oxon. Translated by John Durand. Vol. III. New York: Henry Holt & Co. 1885. Pp. 509. $2.50.

Christian Thought. Lectures and Papers on Philosophy, Christian Evidence, Biblical Elucidation. Second Series. Edited by Charles F. Deems, LL. D. New York: Phillips & Sons. 1885. Pp. 476.

Contributions to the Knowledge of the Older Mesozoic Flora of Virginia. By William Morris Fontaine. Washington: Government Printing-Office. 1883. Pp. 143. With Fifty-four Plates.

POPULAR MISCELLANY.

Correction.—This year's meeting of the American Association for the Advancement of Science will begin Wednesday, August 26th; not on August 20th, as erroneously stated in the July Monthly.

Fallacies about Mines.—Mr. Albert Williams, of the United States Geological Survey, has recently exposed, in a brief monograph, some of the popular fallacies which exist, often to the detriment of miners' interests, regarding precious-metal deposits. First, are local prejudices against certain formations and in favor of others. Most of these prejudices have been contradicted in one way or another, and there is no sufficient reason that any one of the kinds of country rock prevalent in mining districts is more likely to contain metal deposits than another kind. The supposition that the richness of mineral veins usually increases with depth may or may not be justified in a particular case; the only way to find out is to examine. Miners have objections against "specimen" mines, or mines that give unusual superficial promise of richness. Here, again, the only test is by trying, and it is certainly profitable to work the mines so long as they make a paying return, while it will be time enough to stop when they cease to do so. Some miners have favorite strikes, and prefer to work in no others. They are as often wrong as right. One direction of strike may promise best in one locality, and the opposite direction in another. Another miner's fallacy is the belief that the appearance of ores is a trustworthy index of their value. Such a belief, Mr. Williams observes, may seem self-evidently absurd to the experienced miner, but it nevertheless governs many prospectors, who hastily judge from the looks of the rock, when they should have waited for an assay. Notwithstanding the necessity exists for contradicting these fallacies, it would be unfair to infer that the whole subject of precious-metal mining is involved in doubt and perplexity. On the contrary, a great deal of solid fact is now established, room for which has been gained only by clearing away a mass of misconceptions. Much remains to be learned; in fact, the study of precious-metal deposits is only beginning. But it must be admitted that, on the purely practical side, great advances have been made.

Bark Dresses.—The *tapa* of the South-Sea Islanders is made from the bark of the paper mulberry-tree (*Broussonetia papyrifera*), and the bark clothing of the African tribes is prepared from trees of the same family. Dr. Schweinfurth describes one of these trees (*Urostigma Kotschyana*), which is called *rokko* in the country of the Niam-Niams, as standing before every hut, and as cultivated in Monbuttoland. The bark is most fit for use when the trunk is of about the thickness of a man's body. The whole stem is then peeled for a length of some four or five feet, and this without destroying the tree; for the juicy substance around the wood immediately granulates and shortly begins to form a new bark, which becomes fit for use again in about three years. Thus a tree, properly taken care of, may be made to furnish several suits of clothing during its lifetime. The rokko-bark much resembles that of the bass-wood in quality, except that the bark is not quite so thin. By partial maceration and much beating it is formed into a kind of thick and very pliant cloth. In a crude state it is grayish or yellowish, but steeped with a dye-wood it takes a brownish color like that of a common woolen cloth. It constitutes a valuable article of trade in the interior of Africa. The price varies considerably according to

the color and quality, and the ornamented cloths are held as fancy articles, without having a fixed price. Of the colored goods, a dark-gray material is commonly worn by the Witchweri wizards; a dark-red is fashionable among well-to-do people; and a tan-colored ground with stripes and figures in black, called *mtone*, was formerly worn only in royal families, and is still much affected by the nobles in Unyoro and Ruhama, while it has been to a considerable extent supplanted in Uganda by goods from Zanzibar. It can not be bought in the market, but any one who wishes to get a pattern of it must go to one of the great chiefs and give him ample satisfaction in return-presents. The other goods may be bought at their price in cows or cowries. The skins of cattle, goats, sheep and antelopes are also worn in parts of Africa, while the skins of leopards, monkeys, and cats are worn only by privileged persons of royal or noble families.

Private Encouragement of Research.—The fact that the recent proceedings of the Royal Institution acknowledge the gift of £100 by Mr. Warren De La Rue and £50 by Sir Frederick Bramwell to the fund for the promotion of experimental research supports the view that matters of this kind might be trusted to prosper as well under the encouragement of private interest and enterprise as when quartered upon the Government for subsidy. Liberal gifts are seldom wanting to anything that proves worthy of them; and in the former case research will be supported in proportion as it is industriously prosecuted and is of value; while under the Government plan, although enough show of work may be made to draw the pensions, it is by no means sure that so much pains will be taken to make the genuineness and value of the work demonstrable.

Eskimos in Ancient New Jersey.—Mr. A. S. Packard, who has been investigating the history of the Labrador Eskimos, has come to the conclusion that those people formerly had a more or less permanent foothold on the northern shores of the Gulf of St. Lawrence. If this was so, it seems not improbable that they may have made, in very early times, expeditions farther south, to Nova Scotia and New England. This thought leads the author to Dr. Abbott's theory, that the Eskimos inhabited the coast of New Jersey during the river-terrace epoch, which he was at first disposed to reject. Examination, however, has led him to look with more favor upon it, and to think it not improbable that, long after the close of the glacial period, or after the ice had disappeared, and during the terrace epoch, when the reindeer and walrus lived as far south as New Jersey, the Eskimos, being perhaps the remnants of the palæolithic people of Europe, extended as far as a region defined by the edge of the great moraine; and, as the climate assumed its present features, moved northward. This view presented itself while he was collecting the material for his notes, and was confirmed by Mr. Tylor's remarks at the British Association.

The King Country and the Maories.—The "King Country" is a district of about ten thousand square miles in extent in the northern Island of New Zealand, to which the mass of the wild native population of the country have retired so as to be out of the way of the whites, and over which they claim and exercise exclusive jurisdiction to the extent of having, till very recently, held it *tapu* against white men. Mr. J. H. Kerry Nicholls, who lately succeeded in making a running exploration of it, describes it as one of the best-watered parts of the island, with many beauties, and offering many natural advantages for European settlement. In the west it has an extensive coast-line, and a capacious harbor. Dense forests cover a large part of its southern area, and extend northward to the mountains. Westward of this division is a considerable area of open country, while there are vast open table-lands near the snow-clad mountains in the south, and other extensive open plains west of the great Lake Taupo and north of Titiraupenga. The King Country possesses all the rock formations in which gold, coal, iron, and other minerals are found, while its extensive forests are rich in timber of the most varied and valuable kind. Geysers and thermal springs, possessing wonderful medicinal properties, are found in the vicinity of its many extinct craters; and, while it possesses one of the largest active

volcanoes in the world, its landscape is also crowned by the snowy peaks of some of the highest mountains in Australasia. With these important features, it is endowed with scenery of the grandest order, and with a climate unsurpassed for its variety and healthfulness. According to Mr. Nicholls, the Maori people in New Zealand are decreasing; for, while in Captain Cook's time they numbered more than 100,000 souls, in 1881 the number had decreased to 44,099. The three principal diseases conducing to the decay of the race are phthisis, chronic asthma, and scrofula, the first two being principally brought about, Mr. Nicholls believes, by a half-savage, half-civilized mode of life, and the latter from maladies contracted since the first contact with Europeans. "It is, however, clear that there are a large number of natives yet distributed throughout the King Country, and among them are to be found, as of old, some of the finest specimens of the human race. A change of life, however, so different from that followed by their forefathers, has brought about a considerable alteration for the worse among the rising population, and, although during my journey I met and conversed with many tattooed warriors of the old school, who were invariably both physically and mentally superior to the younger natives, it was clear that this splendid type of savage will soon become a matter of the past. I found the natives living much in their primitive style, one of the most pernicious innovations, however, of modern civilization among them being an immoderate use of tobacco among both old and young." At Ruakaka, in the heart of the mountainous forest region, the Maories were found living in the same primitive way as in the time of Cook, and, "when we questioned them as to their religious principles, they told us that they believed in nothing, and got fat on pork and potatoes."

Water-Purification of Sewage. — The important part played by water in the oxidation of sewage has been tested by experiment, and may be accounted forby the quantity of free oxygen that water usually contains. The quantity that may be dissolved is increased with reduction of the temperature. At the summer temperature of 70° Fahr., water contains 1·8 cubic inch, and at the winter temperature of 45°, 2·2 cubic inches, of oxygen per gallon, which is equivalent to four or five cubic inches per foot. From calculations based upon these data, it will be seen that at a temperature of 70° there are 2·58 tons, and at the temperature of 45°, 3·16 tons, of oxygen in every 10,000,000 cubic feet of water. This shows a difference of more than half a ton per cubic foot between these two temperatures. It has been calculated that if a volume of water containing thirty-five per cent of sewage-matter be allowed to flow for one mile, exposed to the air, the whole of the sewage would become oxidized. It has also been estimated, by experiment, that a closed vessel containing water, with five per cent of sewage, gives only thirty-two per cent of aëration on the fourth day, as compared with eighty-four per cent on the day when it is introduced into the vessel. The results of these experiments tend to show that, although the self-purifying power of the water of the river is sometimes overtaxed, it still retains the power of oxidizing sewage-matter; but the question as to whether it has the power of freeing itself from living bacteria still remains to be solved.

The Identity of American Races. — J. W. Powell writes to "Science," pertinently to its review of the Marquis de Nadaillac's "Prehistoric America," that, in his opinion, "there has never been presented one item of evidence that the mound-builders were a people of culture superior to that of the tribes that inhabited the valley of the Mississippi a hundred years ago. The evidence is complete that those tribes have built mounds within the historic period; and no mounds or earthworks have been discovered superior in structure or contents to those known to have been built in historic times." Nevertheless, Mr. Powell considers the doctrine of "the identity of all peoples that ever inhabited the American Continent up to the advent of Europeans" one that is not and can not be held by any intelligent anthropologist, except in some very broad sense, as, for example, that they belonged to the human race, or that they inhabited one continent. In respect to mythologies, languages, and institutions, there are, and have been,

many distinct peoples; and, in respect to arts, there is much diversity, though arts travel from people to people with the greatest ease. At the present time we can not have fewer than seventy distinct peoples among the tribes of North America, and in antiquity the number may have been greater."

Savage Sharp-Shooting.—Concerning the manners and customs of the savages of Mount Sylvia, Formosa, Mr. E. Colborne Baber related in the Royal Geographical Society: "A party of English officers from a man-of-war landed on the island, and, meeting a company of natives armed with matchlocks, challenged them to a trial of skill in shooting. Affixing a mark to a tree about a hundred yards distant, the officers made what they considered pretty fair practice, without, however, astonishing the natives, who, when it came their turn to fire, disappeared into the jungle like one man, and crawled on their bellies through the undergrowth to about three yards from the target, which, of course, they all hit exactly in the center. When the Englishmen protested that such a method of conducting the competition was hardly fair, the natives replied, 'We do not understand what you mean by fair, but, anyhow, that is the way we shoot Chinamen.'"

Emigration from the Old World.—The migrations of European population, says "The Spectator," were never so general, so extensive, and so complex as they are at present. By reason of railways and the cheapening of travel, movements that in any former age would have occupied years are now accomplished in a twelvemonth. The greatest wanderers are perhaps Italians, for the struggle for existence is keener in Italy than in any other European land; the working-classes there have to labor more hours and for less pay than anywhere else. The natural result is an enormous migration of Italian artisans and laborers into neighboring countries; and with them neither Germans, Austrians, nor Swiss can compete. "They are better skilled in their calling and more sober in their habits; and, though they begin by working for lower pay, many of them earn, because they deserve, higher wages than their native competitors. They excel in all sorts of stonework; and at Zürich and some other places architects are in the habit of stipulating that none but Italian masons shall be employed on a job. They built the St. Gothard Railway. They are found as far north as Dresden and Berlin, and the greater part of the engineering work in France is performed by Italian navvies. The Germans, Austrians, and Swiss, displaced by the Italians, push north and west. Many come to England, more go to the United States. . . . It is found in Austria that emigration is most rife in districts where two races are in conflict, and that those most prone to emigrate are of the German race. This is especially the case in Bohemia and Moravia, where the Slav and Teutonic elements are struggling for supremacy; in the north of Hungary, where the Germans have the upper hand; and in Galicia, where the population is Polish and German, and the Jewish element is being increased by immigration from Russia. It would, however, be unsafe to lay down any general law on the subject." It is not probable, for instance, that the Germans emigrate because they are worsted in the struggle for existence, but perhaps because they are more enterprising and far-seeing than their Slavic neighbors and are better able to go. In some instances, the emigration is by masses, as in the district of Wisowitz, in Moravia, which has lost nearly half its population, and in the regions of Tabor and Kuttenberg, where "a veritable emigration fever has prevailed." Austria is making a use of the wandering disposition of its discontented subjects somewhat to its own advantage, by inducing them to colonize in the annexed district of Bosnia.

The Mystery of Eels.—Naturalists are generally agreed that at least three distinct sorts of eels are indigenous to British waters: the silver-bellied or sharp-nosed eel—the one that migrates in the fall—a firm, fine-flavored fish, with an almost black back, a silvery belly, and a fine, sharp head; the grig or snig, a yellowish eel, with a projecting under jaw; and the broad-nosed eel, an uglier-looking animal with a broader head, fierce and voracious in its habits, and of

base tastes. To these a Norfolk fisherman adds a fourth, the "hooking" eel or "gloat," of blackish color and medium size, which is taken by anglers and habbers and on night-lines, and does not migrate. The annual migration seaward of the sharp-nosed eels gives rise to the valuable eel-fisheries of the English rivers, in which the fish are intercepted by wicker traps or eel-sets placed across the river, and in one of which 70,000 have been caught in one night. The moving of the fish is done in the night and always in a dark night; and it is liable to be interrupted by a change of wind, a clap of thunder, or a clearing away of the clouds. What becomes of the immense numbers of eels that descend to the sea every season has never been found out. They are hardly missed from the haunts they have left; yet no one has ever seen any of them returning. In the spring, however, the young eels come up the rivers by millions, keeping close to the banks and swimming in almost solid columns. They will surmount almost any obstacle, creeping wherever there is any moisture, through grass, and over stones and timber. These "eel-fairs" last through several days; and the tiny elvers, about as large as darning-needles, used to be scooped out by the bucketful and applied to the land for manure, baked into cakes for men, or used as food for pigs, until an act was passed prohibiting their destruction. The fact that eels that have once gone down the rivers never return is asserted positively by all who have observed them. The question is then in order, How is the supply in the rivers kept up; and how is it that the eels found in the rivers are of a large size? The answer is, that young eels are produced in the rivers, and that eels are so numerous that, although immense numbers leave the rivers every year, yet equally immense numbers remain. The migrations have been generally supposed to be for breeding-purposes; but there are reasons for believing that breeding takes place in the rivers as well as in the sea, so that this alone can not explain them; and it has been suggested that they are a kind of swarming, like that of bees, impelled by excess of numbers. Naturalists affirm that the eel is an oviparous animal, and that it deposits its spawn as other fish do, and point to the presence of spawn and milt in it as revealed by the microscope; but the eel-fishers and eel-setters declare that it is viviparous; "that they have constantly opened eels in February which have been full of minute living eels (not parasites), and that in a tub of eels young ones have been found in the morning that were not there overnight. . . . To use their own words, there are thousands and thousands of eel-fry all alive in the bodies of eels cut open in February."

Dangers from Industrial Dusts.—A paper was read by Dr. Henri Napias before the Congress of Industrial Hygiene, held at Rouen in July, 1884, on the dusts developed in industries and the methods of guarding against injury from them. Dusts in the air call for especial consideration, from the fact that, besides vitiating the atmosphere in the way that gaseous impurities also do, they exert a mechanical action when brought in contact with the respiratory and digestive system. Even when they are wholly without toxic or essentially irritant effects, they are foreign bodies and obstructive, and are always in danger of exerting a traumatic action or causing abrasions. They are, therefore, all dangerous, while the dangers arising from them may be various in character. Mineral dusts, whether of stones or of metals, are the most dangerous, because, besides being hard and sharp and liable to cut the tissues, very many of them are also poisonous or caustic. Dusts of organic origin are less dangerous, but they vitiate the air, communicate unpleasant qualities to it if they are of an animal nature, and are frequently vehicles for the conveyance of infectious germs. Various inconvenient affections of the lungs are caused by breathing these dusts, among which may be counted phthisis, not as produced directly by them, but as often ultimately induced by the abrasions or deterioration of the tissues which they immediately occasion. The readiest and most available means of removing dusts is by ventilation, and, when this can be so directed as to take them away as soon as they are formed, it is almost sovereign. It will not do, however, to rely upon general ventilation, for that will at most remove the dusts but imperfectly, while its usual operation will be more likely to distribute

them more widely among the operatives. The remedy should be applied to light dusts by means of chimneys or draught-flues; and to the heavier ones by means of blasts to drive them away. In cases where the dust itself is the object of the manufacture, or is to be applied in the manufacture, the remedy is to conduct the processes in closed apparatus. When either method is practicable, the dust may be kept down or removed by water, or the articles may be worked in a moist condition. Some workmen employ masks or respirators as means of individual protection, and they may in some processes be the only efficient means available. They are liable to the objection that they are always cumbrous and inconvenient; and frequently the workmen will become careless about them, or refuse to be bothered with them, and will leave them off. They should not be depended upon when any practicable means of keeping down or removing the dust can be employed.

Gambling at Monte Carlo.—Dr. J. H. Bennett gives in the "Pall Mall Gazette" some impressive illustrations of the enormous influence for evil of the gambling establishment at Monte Carlo, Monaco. The extent of it may be best understood by a simple calculation which the author owes to a professional gambler. The chances of the table are one in thirty-six in favor of the bank, and its annual gains, after all its expenses are paid, are $3,500,000. Hence $126,000,000—and thirty-six times its expenses in addition—have to be staked in it, won and lost, every year. "It is this fact of the gambler dealing with large masses of money that partly accounts for the strange fascination exercised by gambling. A careful player, who begins with, say, a thousand pounds capital, may have fingered, according to the doctrine of chances, thirty-six thousand pounds before he loses his capital. If he play long enough, the bank royalty of one in thirty-six is sure to swallow up his capital; and then he has had all the emotion of having been alternately successful or the reverse, rich or poor. He regrets when he has at last lost his initial capital that he did not stop when successful, which he never does, vows that he will be more prudent next time, and, in order to have the chance, sells, borrows, raises money anyhow." These facts destroy the argument brought forward by the patrons of the public tables, that playing at them is more straightforward and fairer than private club gambling, and that, as long as the latter is allowed, the former should not be interfered with. "At a public gaming table the bank royalty must inevitably ruin all who play constantly long enough to have risked their capital thirty-six times, even if the playing is carried on honestly, if such a term can be used. . . . Regular gamblers find this out in the long run, and learn to avoid the public establishment," resorting to the gaming clubs or forming them; and this is the explanation of the brood of gambling clubs, casinos, etc., which rise up, as at Nice, in proximity with the public gambling establishment. "They proceed from it, are created by it, would not exist without it. . . . When I first inhabited the Riviera" (in 1859), continues Dr. Bennett, "the Monaco gambling-house was a mere gambling club or casino, which excited but little notice. Now it has become the great attraction, the great fact. Half the people one meets are going or have been to Monte Carlo."

"Anti-fouling" Paint for Ships.—Because iron and steel are peculiarly liable to corrosion when immersed in salt-water, vessels made of them require special protection. This can be given by covering the metal with some alkaline or basic substance, or the oxide of some metal electro-positive to it. Caustic lime and soda are very efficient for this purpose, and act equally well when made into a paint with oil. But their efficiency is destroyed when they cease to be caustic, or when they are saturated with carbonic acid, which they absorb freely from the air. Magnesia is equally efficient, and does not absorb carbonic acid. It therefore makes as good a material for a paint as could be desired, and, moreover, forms an excellent basis on which to lay an anti-fouling paint, which it protects from the galvanic action of the iron by isolating it, while it does not affect its anti-fouling qualities. Without the protection thus afforded, the iron not only effects the decomposition of the anti-fouling paint, but it also by contact takes away the anti-fouling qualities of that

part of the paint which it does not decompose. All of the best anti-fouling paints depend for their efficacy on some compound of mercury or copper, while the action of iron is very strong in contact with both these metals; hence perfect isolation of the paint from the iron is necessary to make them of any value. Besides paints of magnesia and alumina, spirit and benzoline varnishes, powdered coke, anthracite or coal, lime, cement, and various kinds of silicates, mixed or suspended in oils, have been found good in greater or less degrees for these purposes. Zinc oxide also has some slight merits, while red-lead paint, which has been used, is "out of the question. It is bound to give out after a certain time; and, besides, the metal beneath is corroded."

The Teak-Tree and its Timber.—The teak-tree is found growing in various places in the East Indies, through a region reaching from the eighth degree of south latitude in Java to about the Tropic of Cancer, and of undefined extent in longitude, but not farther west than 72° east. Its vertical *habitat* is about 3,000 feet above the level of the sea, but seldom below 2,000 feet. Its northern limit is in Bundelcund, where it is found in specimens not tall, at elevations rising as high as 4,000 feet. It grows in groups, a circumstance which is very convenient in trade. The wood is held in the highest esteem by ship-builders, and is preferred to any other for the backing of iron-clad vessels. It shrinks hardly any, is considered the strongest and most durable timber of India, or perhaps of the world, and resists the attacks of white ants. The qualities of the timber vary greatly according to the character of the soil on which it grows, sometimes so much as to induce the belief in different species; but close examination has shown that, though varieties may exist, there is but one species. In Java, the Government have control of 1,650,000 acres of teak, besides new plantations. The planting and raising the trees, and mode of felling, classing, and measuring the timber are carefully regulated. Forest reserves of considerable extent exist in various parts of India, from some of which specimens have been shown more than 100 feet long, and 93 and 100 inches in circumference at the base. One of the chief sources of supply is British Burmah, where the total area of the reserve forests is 3,274 square miles, and 836 square miles were added during 1881–'82. Nineteen thousand teak-trees were girdled, and 130,000 tons or 6,500,000 cubic feet of the timber were exported during this year from Rangoon and Maulmain. The principal forests are near the Irrawaddy River, where water conveyance is easy and ship-building is prosperous. A very fine plantation has been established at Nilambur, on the river Beypore, in Malabar, where 100 acres are planted each year, and there are now about 1,800,000 trees. An increasing source of supply is also being developed in Siam. According to Colonel Beddome, the growth of teak is very rapid, compared to that of the oak. The growth in the sapling state may be calculated at about one or two cubic feet a year; but after thirty years it is immensely accelerated, and an increase of five cubic feet has sometimes been remarked in a year. Several other trees, but little known as yet, are mentioned as nearly equal in value to the teak. The takieng, besides being a rival to it in size and quality, possesses the advantage of being easily bent by artificial means. Sir Robert Schomburgk saw a log of it measuring 135 feet, perfectly sound, in the building-sheds of the King of Siam. The red peema of Burmah and Tenasserim is considered equally useful with teak, as is also the touk-kyan, with its dark-brown wood. Angely is well suited for the floors and bottom-planking of ships, but has to be used with copper, as it corrodes iron. Jackwood, a tree of the same family (*Artocarpus*), furnishes an excellent fancy and furniture wood, and is admirably adapted for boat-building. An Australian timber called tuart is believed by Mr. Simpson to be superior to all others for the backing of armor-plated vessels, as it can not be split by any possible means.—*From a paper read by Mr. P. L. Simmons before the Society of Arts.*

The Duk-duk.—According to Mr. Wilfred Powell's "Among the Cannibals of New Britain," affairs in the Duke of York Islands are regulated by an officer called the duk-duk, who appears to combine in

himself the functions of judge, police officer, and executioner. He is distinguished by his peculiar dress, and by his helmet, which, reaching down to his shoulders, quite conceals his face. It is made of basket-work, so that the wearer can breathe freely, and is painted in front as a terrible face. When any person is accused by his neighbor or otherwise blamed, he must pay the duk-duk a sum of money as damage, and this officer goes in person to the house of the accused to see that all is made right. If the accused will not settle, his house is burned or he is speared. Women and children dare not look at the duk-duk, for fear they will die on the spot, and therefore run away and hide, whenever they know, from the peculiar cry he utters to give notice of his approach, that he is coming. Men may be initiated into the mystery of this office when they reach a certain age, on payment of a prescribed sum, and, if they do not do this, they must keep out of the way of the duk-duk. The initiated must never speak of the secrets of the mystery out of the spot that is consecrated to it, and the uninitiated must not go to that spot.

Temperature of the Glacial Period.—Some geologists hold that the glacial phenomena were the result of warmer, not of colder, conditions of climate than now exist. Their views are briefly summarized by M. Millot, of the scientific faculty of Nancy, France. For the production of glaciers in temperate latitudes an active evaporation at the equator, to furnish moisture to be condensed into snow on the mountains, is above all things necessary. Thus, the quantity of ice produced will be within certain limits proportioned to the heat received at the equator. No heat, no evaporation; no snow, no glaciers; on the other hand, there will be no glaciers if it is too hot for the snow to be deposited on the mountain-tops. This was probably the case before the glaciers appeared. Then, as the heat of the sun gradually diminished, as it is supposed to be doing regularly, the glaciers begun on the mountains, small, but growing, for the evaporation at the equator was still infinitely greater than it is now. So it may have continued for ages, the snow condensing on the mountain-tops, and the sun lifting up immense quantities of water to be condensed. This was a period of maximum favorable conditions for glaciation. Then, the sun still cooling, the amount of evaporation fell off, till it ceased to afford the excessive supply, and the glaciers became stationary, then retrograde till they were reduced to the relatively insignificant proportions in which they now appear. This theory explains the deposition of glacial moraines in the midst of tree-ferns and a Mediterranean vegetation; for, while the glaciers were extensive in consequence of the immense precipitation everywhere but immediately upon them, a warmer climate prevailed than is now enjoyed in the same regions. This theory explains also how Arctic animals, finding suitable conditions of existence in the glaciated districts, came to be mixed up, as is shown by their remains, with the herbivorous animals of milder climates, which were separated from them only by a line. This theory, unlike all other theories of the glacial period, does not require the supposition of any interruption of the regular, normal order of climatic development and events.

Arts and Customs in New Guinea.—Mr. Coutts Trotter, in an address before the Royal Geographical Society, stated that while the people of New Guinea are still in the "Stone age," their artistic faculty is strongly marked, especially among the western tribes. This is shown conspicuously in the carved ornamentation of their canoes, houses, implements, and weapons. Their tastes are further seen in the habit of adorning themselves with flowers and leaves — of crotons, dracænas, coleus, begonias, scarlet hibiscus, and the anise-scented clausena. They are also alive to the advantages of trade, the tribes on the western coast having for centuries been exchanging the varied products of the country with the Malays, Bughis, Chinese, and others, for cotton cloths, iron and copper wares, knives, beads, mirrors, indigo, and arrack. In conducting their inland trade among themselves, they assume that inter-tribal war is the normal condition of man, and adopt ingenious devices to mitigate inconveniences. But even the plan of set-

ting apart for each hill-tribe its allotted station on the coast is not always sovereign for the avoidance of collisions. The people of the southeast peninsula make long voyages to the west of the Gulf of Papua for sago, in strange craft composed of several canoes lashed together, with a house at each end. Each village or district often has its trade-specialty, as, for example, for pottery, or for canoes, or shell or other ornaments. Salt is in great demand, especially in the interior, whither sea-water is sometimes carried in hollowed bamboos; or salt is obtained by burning the roots of trees which have grown in the salt water. The people in most parts are skilled agriculturists, and grow, generally with the help of artificial irrigation, all the usual plants of tropical Pacific culture, most of which—with probably the traditions of scientific agriculture—seem to be of Asiatic origin. Any one may clear and cultivate a piece of land within the territory of his tribe, but they have a strong sense of proprietorship, even of the fruit-trees in the forest, and of the fish in their own streams, or their own tract of coast. The social and political organization of the people is quite rudimentary. The chiefs have but little power. Important matters are settled by the assembly, and, otherwise, every man, beyond conforming to certain established customs, is a law to himself.

How to live One Hundred Years.—How to live a century and grow old gracefully are discussed in a pamphlet under that title recently published by Dr. J. M. Peebles, who appears to have faith in the practicability of both his propositions. Success depends upon many elements, among the most tangible of which are air, sleep, food and drinks, and clothing. We must breathe pure air, and breathe deeply; not be afraid of night-air, and get as much of our air out-of-doors as we can. As to sleep, "I say," says Dr. Peebles, "to my friends and patients, 'get up; get up at five o'clock in the morning'; and I set them the example. If they want more sleep I say, 'take it; take all you want; take eight hours; take nine hours; take ten hours, if you choose; but take them in the early hours of night rather than by daylight. Don't insult Nature.' If you get angry, take a bath and go to bed and sleep; if the world abuses you, take extra sleep; if you are dyspeptic and discontented, take a long, sound sleep, and, waking, you will find that all the world is smiling." For diet, the vegetarian and farinaceous system is recommended. For drink, water, which should also be applied freely and frequently outside, while intoxicating liquors, tea, coffee, etc., are best left alone. The clothing should always be arranged with a view to protection against variations of heat and cold, and with no other, and should not be allowed to impede any of the functions or movements of the body. Dr. Peebles thinks that there may be good in medicines, notwithstanding all that is urged against their use by many writers on hygiene, and says: "If there were no pre-natal weaknesses, no transmitted blood-poisons or hereditary tendencies; if there were no sudden climatic changes; if there were no violations of the physical, mental, and moral laws of God, medicines would be quite unnecessary. But, as rational, practical men, we must take human beings precisely as we find them; and we find many of them wretchedly begotten, badly cared for in infancy, unwisely trained in childhood, wickedly tempted in youth, and in manhood frequently exposed to winds, pelting storms, and the low malarial lands of the Western prairies. Thus conditioned, human ills, aches and pains and diseases are absolutely unavoidable, and accordingly remedies — medicinal remedies — carefully selected and wisely administered, are positive necessities." Finally: "Exercise charity toward all, control your passions, govern your appetites. Develop and manifest a sweet and peaceful spirit. Carefully observe the rules of health; . . . and, with a fair constitution to start with on the journey of life, you may easily live a full century."

Do Insulated Conductors attract Lightning?—A house in Neufchâtel, Switzerland, was struck by lightning and burned last summer; and it was suggested that the electric stroke had been invited by a lot of old iron that was stored in the attic. M. Calladen, speaking in the French Academy of Sciences of this suggestion, remarked that the mere presence of metal, without communication

with the earth, could not have any material influence in attracting the lightning from the clouds; if it had, then the houses with tin roofs, many of them without lightning-rods, now so common, would be in great danger, whereas they are not struck oftener than houses with tile roofs. The presence of iron, however, might increase the danger of fire after the house had been struck; for, if we place a combustible substance between two conducting surfaces, it is generally sure to take fire when an electric current is passed through it from one of the conducting surfaces to the other. So, if lightning should strike a house, it would find its way to any masses of metal within the building and ignite whatever combustible matters it passed. In view of this fact, and of the present very extensive use of metal in house-construction, the provision of suitable conductors to divert electrical currents from the combustible parts of the building has become more important than ever.

Was it Volcanic or Cosmic Dust?—Mr. W. Mattieu Williams is of the opinion that the long continuance of the glowing twilights tells against the validity of the volcanic-dust theory; for that dust must have settled by this time, or, if so much of it has continued to float in the atmosphere, it should have shown its presence more palpably than it has done. The two alternative hypotheses to this one, worthy of serious consideration, are: 1. That the earth, and possibly the whole or a large portion of the solar system, has, in the course of its journey through space, passed through a region unusually rich in meteoric dust; or, 2. That an unusually large amount of aqueous vapor has been raised to the upper regions of our atmosphere by increased solar activity. Apparently in favor of the meteoric theory is the statement of F. Mangini, that on three days in February and March, 1885, when the glows, accompanied by rain, were especially remarkable, he collected at Reggio, in Calabria, some new-fallen red dust, which, when examined under the microscope, seemed to consist of mica, quartz, and irregular polyhedric crystals. Analysis brought out magnetic iron oxide, sulphuric and phosphoric acids, silica, calcium, magnesium, aluminum, nickel, and arsenious, ferric, and manganous oxides. The dust did not come from Etna, because the wind was blowing in the opposite direction, and Etna dusts are black; nor from the Sahara, because Sahara dusts contain no iron.

Oranges in Palestine.—The climate and soil of Palestine are well adapted to the cultivation of the orange, which, according to Consul Merrill, there suffers from no diseases or parasites of any kind. The trees appear to flourish best near the sea, and the orange-groves are for the most part near Jaffa and Gaza. In Jaffa there are five hundred gardens, of which one hundred and fifty are ranked as first class, all the gardens together containing about 800,000 trees. The trees are set about fifteen feet apart, while the ground between them is planted with small fruits or vegetables. The sweet lemon is used as the stock, and the variety of orange desired is grafted upon it. The trees are watered every week in the summer, at a cost per season of about one fifth the value of the crop in gardens of the first class. The Jaffa oranges proper, the only kind exported, are oval, or lemon-shaped.

NOTES.

M. Domeyko has summarized the results of forty-six years of observations on earthquakes in Chili. They are more frequent in the northern part of the country, where there are no volcanoes, and the Andes are fifteen thousand feet high, than in the southern part, where there are volcanoes, and the mountains are only a third as high. The effects of the shocks on buildings depend more on the nature of the soil than on the violence of the spasms. The sea-phenomena are of two kinds: local, or oscillating, when the waters retire to beyond the lowest-water mark, to return in waves a hundred feet high beating upon the coast and destroying everything they reach; or, when the shocks occur at a distance, the water runs along the coast in a grand wave without previously retiring. In the more severe earthquakes, when there are several shocks in the same day, it is generally the second or third one that produces the greatest destruction. The destructive effects of an earthquake are never as considerable in the interior of a mine as at the surface.

M. Quentin Paul Desains, of the Physical Section of the French Academy of Sciences, died after a very short illness, about

the 1st of May. He was born in 1817, and had been a professor in the Colleges of Caen, Stanislas, and Bourbon, and a member of the Academy since 1873. He was the author of several valuable papers on the laws of radiant heat, the polarization of the calorific rays, the latent heat of aqueous vapor, etc.

M. JAMIN attributes the cold nights usual in April and May to the fact, which he deduces from the experiments of Mr. Glaisher and others, that the minimum of vapor in the atmosphere prevails then, the maximum being in August.

M. EDOUARD HECKEL, of Marseilles, has called attention to a new prospective source of gutta-percha in the *Butyrospermum Parkii*, or *Barsia Parkii*, of the interior of Africa, from the seeds of which the natives already extract a kind of butter. The plant possesses many advantages. It is very widely diffused; it will grow apparently in the most desert, gravelly soil; it matures in four years; and it is available to a certain extent, to native taste, as a food-plant.

M. DIEULEFAIT has been inquiring why there is so much sulphur in stone-coal, and why there is so little of free alkaline carbonates in the ashes. For that purpose he has analyzed the surviving species of the families of the coal-plants, particularly the *Equisetaceæ*, and has found in them a greater than the usual proportion of sulphuric acid. Hence he deduces, as the answers to his questions, that the coal-plants were more highly charged with sulphur than most existing plants; and that, for that reason, their alkaline constituents assumed the forms of sulphates instead of carbonates.

THE chimney of a manufactory in Breslau, about fifty feet high, is made of pressed paper, a substance which, it is remarked, has almost perfect powers of resistance to fire.

M. ADMIRAL MOUCHEZ has taken, at the Paris Observatory, distinguishable photographs of stars of the fourteenth magnitude. On a plate about ten inches square he has photographed a field of about five degrees square on which are shown 2,790 stars of between the fifth and fourteenth magnitudes, equally clear in the edges and the center of the picture. Stars of the fifteenth magnitude can be discerned in the negatives, but they were not clear enough to be transferred to the paper. It is estimated that, if the stars are distributed over the whole sky as thickly as over these five degrees, then the total number of them is 20,500,000.

A COMMISSION of inquiry respecting the earthquake in Ischia of July, 1883, appointed by the Italian Government, has reported that the number of victims of the catastrophe, not counting mere contusions, was 3,075, of whom 2,313 were killed or died in the hospitals, and 762 were wounded. Of the 672 dwellings in Casamicciola, 537 were wholly destroyed, and only one wholly escaped injury; of the 4,300 inhabitants of the town, 1,784 were killed. At Ischia town the shocks were strong, but no serious harm was done. Accommodation was provided after the disaster for 9,500 unhoused inhabitants of the island, in 700 temporary barracks of corrugated iron.

OBITUARY NOTES.

PROFESSOR FLEEMING JENKIN, of the University of Edinburgh, died June 12th, in the fifty-third year of his age. He was distinguished in locomotive and constructive engineering art, and in connection with the laying of cables, including the first transatlantic one, and general telegraphy. He was made Professor of Engineering in University College, London, in 1865, and in the University of Edinburgh three years later. He has written several papers in engineering and electrical science, and was the author of the article on "Bridges" in the "Encyclopædia Britannica."

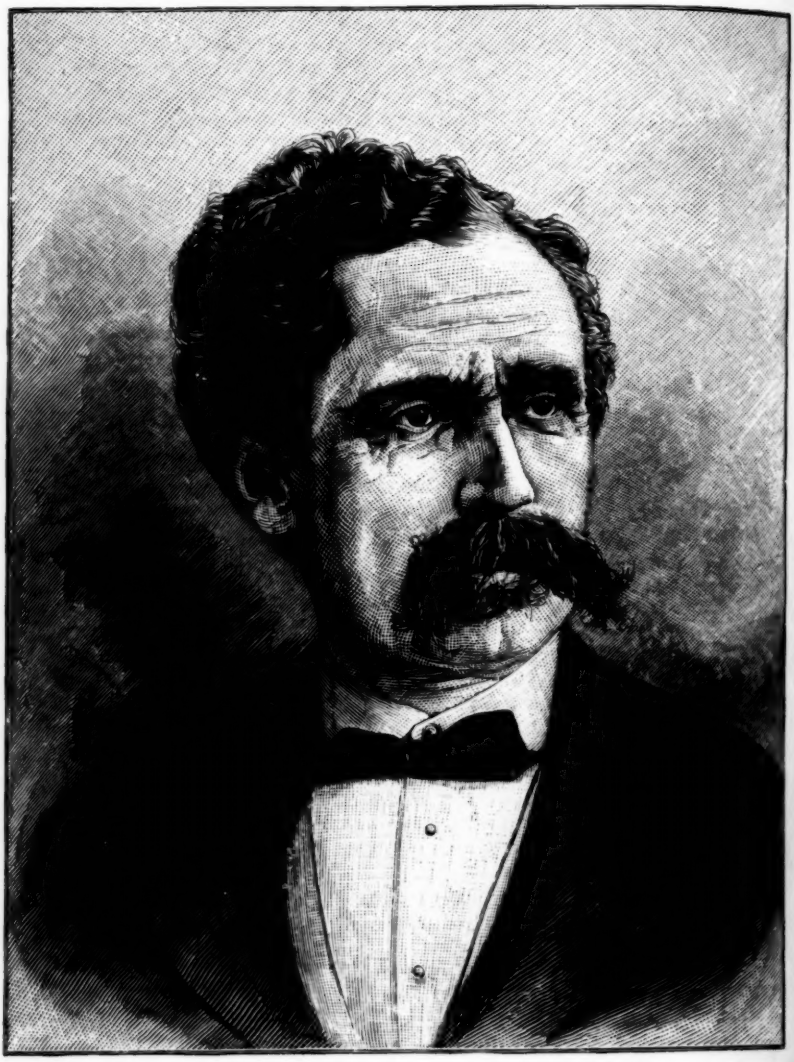
LIEUTENANT TILLY, the leader of one of the German West African exploring expeditions, has recently died in the Cameroons.

MR. ALEXANDER CROALL, Curator of the Smith Institute, Stirling, Scotland, is dead, in the seventy-seventh year of his age. He was the author and illustrator of "Nature-printed British Sea-weeds."

MR. ALEXANDER MURRAY, formerly of the Canadian Geological Survey, died in the early part of this year. He was born in Scotland in 1811, and, after serving in the British Navy for several years, went to Canada about 1837. He was invited by Mr. W. E. Logan to join the geological survey of the province, which was about to be begun, and, having no previous knowledge of the science, qualified himself for the work by special studies. On the survey he was able and efficient, and superintended a large part of the work for twenty years. He had charge, from 1863 to 1883, of the geological surveys of Newfoundland, the collated reports of which, published in 1881, are our chief sources of information on that subject.

THE Rev. T. W. Webb, of Hereford, England, author of "Celestial Objects for Common Telescopes," and of numerous articles on observational astronomy, died May 19th.

THE anatomist, Professor Henle, of Göttingen, died on the 13th of May last.



GUSTAV NACHTIGAL.